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Alpha Desynchronization during Empathy for Pain  
is modulated by Racial Group Membership  
- An EEG Study

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## **ABSTRACT**

Although social psychology argues that racial stereotypes and prejudice are related to less empathy, studies examining this relationship in the field of neuropsychology are rare. 37 White participants were presented videos showing White or Black hands being either penetrated by a needle (pain condition) or touched by a Q-tip (no pain condition) while we measured desynchronization of the alpha range (7-14 Hz) employing EEG. 32 participants were presented the same stimuli as the other 37 participants, with the difference that in this EEG session the hands were digitally colored violet in order to control for the factor of visual familiarity with the stimuli. In line with the paradigm 'empathy for pain', pain conditions elicited greater alpha desynchronization than did no pain conditions in the frontal, central, parietal and occipital area. This empathy for pain response was significantly lower for original colored Black stimuli than original colored White stimuli in the central, parietal and occipital area. Since in the central area this empathy for pain response was similar for original colored White, unfamiliar violet colored White and unfamiliar violet colored Black stimuli, but lower for original colored Black stimuli, the visual familiarity with the stimuli did not influence that empathy for pain was modulated by racial group membership. We argue that the alpha desynchronization we assess can be interpreted as somatosensory alpha desynchronization, because pain stimuli are somatosensory in their nature, because somatosensory desynchronization was mainly found in a time interval in which no motion is present in the videos and because other studies from our research field also defend interpretations of suppressed somatosensory oscillations and somatosensory desynchronization. The empathy for pain response correlated with painfulness and unpleasantness ratings of the EEG stimuli as well as with an explicit measurement of personal distress. The electrophysiological racial bias for empathy for pain did not correlate with implicit or explicit measurements of racial bias. However, a racial bias calculated based on painfulness and unpleasantness ratings of the EEG stimuli correlated with White preference and feelings towards Blacks.





## **Introduction**

It is hypothesized that empathy has evolved because of the evolutionary advantages it brings with it; advantages such as being safer from predators and danger, being cared for from birth by other members of the group, and having rewarding emotions of affiliation and love for others. Hence, one could say that empathy is the core social ability that allows us to live in social groups. Importantly though, as Allport (1954) pointed out in the 1950s, the existence of an in-group, a group such as one's family, one's neighborhood or one's city, always inherently implies the existence of an out-group. This raises the question of whether individuals have more empathy for a member of their in-group than someone considered to be in an out-group. In fact, studies from the field of Social Psychology have already found support for the hypothesis that racial group membership modulates empathy (Yabar, Johnston, Miles, & Peace 2006; Stürmer, Snyder, Kropp, & Siem 2006). Just recently, the young field of Social Neuroscience has begun to investigate the relationship between racial group membership and empathy for pain - 'empathy for pain' describing the phenomenon of having empathy when seeing someone else in pain. So far, it has been found that racial bias modulates affective components of empathy for pain measured with fMRI (Xu, Zuo, Wang, & Han 2009) and motor components of empathy for pain measured with TMS (Avenanti, Sirigu, & Aglioti 2010). However, to our knowledge no study has yet assessed whether racial bias modulates somatosensory components of empathy for pain. This thesis addresses the question of whether alpha desynchronization measured with EEG during empathy for pain is modulated by racial group membership. We argue that the alpha desynchronization we assess can be interpreted as somatosensory alpha desynchronization, because our pain stimuli are somatosensory in their nature, and because somatosensory desynchronization is generally found in a time interval in which no motion is observable in our stimuli. Furthermore, other research from our field defends this interpretation of suppressed somatosensory oscillations and somatosensory desynchronization (Stancák, 2006; Cheng, Yang, Lin, Lee, & Decety, 2008; Whitmarsh, Nieuwenhuis, Barendregt, & Jensen, 2011).

In order to master the endeavour of presenting our study in a structured way, the following outline for this thesis was developed:

First, the theoretical background on empathy is reviewed by highlighting etymological roots and definitions of empathy, differentiating empathy from sympathy, discussing in detail how and why empathy might have evolved, describing how empathy might lead to prosocial behavior and explaining how bottom-up and top-down processes of empathy develop (see chapter „1.1 Definitions of Empathy“). Afterwards, it is explained that in the field of Social Neuroscience empathy is usually assessed with the paradigm ‘empathy for pain’, neuroscientific research on affective, motor and somatosensory components of empathy is reviewed, followed by the specific description of how the most recent studies employ the event-related desynchronization method to assess somatosensory desynchronization during empathy for pain (see chapter „1.2 Neuroscience of Empathy“). The theoretical portion continues with a section illustrating the relationship between empathy and racial group membership, and a discussion of the fact that only affective and motor components, but not somatosensory components of empathy for pain have been past targets of research. Concluding this section, there is an explanation of why one also has to consider the factor of familiarity when looking at the relationship between empathy and racial group membership (see chapter „1.3 Empathy, Racial Group Membership and Familiarity“).

Based on this theoretical part, the empirical part begins with the research question and design for this study including detailed hypothesis (see chapter „2 Design“) and then continues with the methodological realization of the study including descriptions of participant characteristics, stimuli, procedure as well as EEG and behavioral measurements (see chapter „3 Methods“). Finally the results of this study are reported (see chapter „4 Results“) and discussed (see chapter „5.1 Interpretation of Main Results). The thesis concludes with ideas for future research (see chapter 5.2) and theoretical and practical implications (see chapter 5.3).

## **THEORETICAL PART**



## **1. THEORY**



# **1. THEORY**

## **1.1. Definitions of Empathy**

### **1.1.1 Empathy as a Construct**

In the realm of the German movement of psychological aesthetics, Robert Vischer invented the term “Einfühlung” in 1873 to describe the notion of feeling into something, to see it from the inside (Vischer, 1873). The term was greatly promoted by works on art and aesthetics from the German philosopher Theodor Lipps - causing Sigmund Freud to write about it in terms of understanding a joke or even understanding one’s patient by putting oneself in his or her place (Pigman, 1995). In order to translate Einfühlung Edward Titchner coined the English term ‘empathy’ in 1909 (Wispé, 1968). In the 1950’s the term empathy was mainly used to describe a cognitive process in clinical settings, but in the 1960’s social psychologists began to use the term more in the context of feeling a congruent emotion with someone else (Batson, Fultz, Schoenrade, 1987). Then, in the 1970’s the term began to be used even more narrowly, being defined as emotions that are more other-focused than self-focused (Batson et al., 1987).

Daniel Batson (2009) disentangled the various definitions psychologists have given the term ‘empathy’ by describing eight related but distinct phenomena attributable to it:

- Concept 1 “knowing another person’s internal state, including his or her thoughts and feelings” can be thought of as cognitive empathy;
- concept 2 “adopting the posture or matching the neural responses of an observed other” is related to imitation and motor or facial mimicry;
- concept 3 “coming to feel as another person feels” describes affective empathy or emotional contagion;

- concept 4 “intuiting or projecting oneself into another’s situation” is also called aesthetic empathy;
- concept 5 “imagining how another is thinking and feeling” is mostly referred to as an “imagined other” perspective;
- concept 6 “imagining how one would think and feel in the other’s place” is also referred to as an “imagine-self” perspective;
- concept 7 “feeling distress at witnessing another person’s suffering” describes the important concept of personal distress;
- concept 8 “feeling for another person who is suffering” relates to empathic concern or simply ‘sympathy’ (Batson, 2009, pp. 4-8).

In sum, the broad multidisciplinary field of empathy research - reaching from conceptual analysis of philosophy to empirical investigations of science - has led to countless definitions. However, studying these definitions one can reach the conclusion that empathy is a psychological construct being latent in nature, not directly observable and therefore only definable in hypothesis and manifest processes that work on this hypothesis. In the realms of this thesis empathy will mainly be studied as it relates to the following definition by Jean Decety:

Empathy is “the ability to recognize emotions and feelings of others with a minimal distinction between self and other” (Decety, 2010, p. 258).

### **1.1.2 Difference between Empathy and Sympathy**

Sympathy is an older and more frequently used term than empathy; Chismar elaborates “it was used by Galens and Hippocrates for an affection or sensitivity of the body, while Aristotle used it to speak of being affected by like feelings. Epicurus spoke of sympathy in terms of a sense of affinity or Koinonia, and the Stoics appealed to the ‘sympathetic vibrations’ found in music. The term became



especially prominent in the eighteenth century in the writings of the British moralists” (Chismar, 1988, p. 258).

Even though the terms empathy and sympathy sound very similar, they are crucially different from each other. While to empathize means that one recognizes and shares another’s observed emotional state, to sympathize means that one empathizes and in addition has a positive regard or concern for the other person - in other words: while one might empathizes with all characters of a novel, one is likely to sympathize only with the hero (Chismar, 1988). Eisenberg and Eggum (2009) therefore pointedly conclude that empathy can evolve into sympathy.

### **1.1.3 Evolutionary Functions of Empathy**

In regard to the question why we are empathetic, one could answer shortly because it gives us an adaptive advantage to the environment in the struggle for life. Being able to understand other’s emotions helps one’s self to avoid pain, risk and hunger. An example in a typical fight-or-flight situation: When one individual of a group detects a predator and expresses fear or aggression, it is very helpful that other members can immediately understand the emotions of the distressed individual. In doing so, members of the group are either able to help the individual in distress, or flee and at least save their own life in the presence of danger. Also, this ‘more eyes’ phenomenon - meaning more eyes can detect predators - “allows individuals to spend more time on other activities that promote reproductive success such as feeding and finding mates” (Preston & de Waal, 2002, p. 6). However, surviving predators is only one of many evolutionary tasks in which empathy plays a key role. Another one, for example, is maternity care: The ability of parents to empathize with their child directly relates to their ability to provide the right care and ultimately ensure the child’s survival, and thus the survival of their genes into the next generation. Taking this argument further, one also has to speak about the more socially bonding functions of empathy. For instance, members of a social group may express their

empathy for one another by means of mimicry, meaning that they may “automatically and continuously mimic and synchronize their movements with the facial expressions, voices, postures, movements, and instrumental behaviors of others” (Hatfield, Rapson, & Le, 2009). This allows them not only to have emotion contagion, catching the emotions of others (Hatfield et al., 2009), but very importantly to create affiliation and rapport in a non-conscious way (Lakin & Chartrand, 2003). In fact, people who experienced failure to affiliate in an interaction, demonstrate more mimicry later (Lakin et al., 2003). It is such affiliation and rapport that is highly necessary for well-functioning groups and societies. Hence, Carter, Harris and Porges (2009) arrive at the conclusion that the phenomenon of empathy is not only closely linked to self-awareness but also social awareness. In sum, being able to understand the emotions of others by empathizing allows oneself to live in social groups and strive from evolutionary advantages that this brings with it - such as being safer from predators and danger, being cared for from birth by other members of the group and having rewarding emotions of affiliation and love for others.

When discussing these things, it is fundamentally important to distinguish between proximate and ultimate causes; according to Mayer “proximate causes govern the responses of the individual (and his organs) to immediate factors of the environment while ultimate causes are responsible for the evolution of the particular DNA code of information with which every individual of every species is endowed” (Mayer, 1961, p. 1503). Ultimate causes can be described by the perception-action model of empathy by Preston and de Waal (2002) which explains that perceiving a kin member performing an action often automatically leads to oneself performing the same action - sometimes without even noticing it. For example, social facilitation experiments with hyenas that live in captivity showed that when one hyena drinks there is a 70 percent probability that an observing hyena drinks in the next few minutes (Glickman, Zabel, Yoerg, Weldele, Drea, & Frank, 1997). Preston and de Waal (2002) argue that in the context of empathy when helping a distressed neighbor, a proximate explanation would be that you feel their pain and an ultimate explanation would be that eventually you would want them to reciprocate. Hence, one way of

interpretation would be that the most ultimate function of empathy is kin selection, meaning that you, your kin, and therefore the genes of you and your kin survive into the next generation.

Another question the evolutionary perspective is able to address is whether animals have empathy. In this regard, often the term “emotion contagion” is used, which Singer and Lamm (2009) describe as phenomenon that is more primitive than empathy and often precedes it; they define emotion contagion as “tendency to catch other people’s emotions” (Singer & Lamm, 2009, p. 83). Results of a number of studies show that animals at least experience emotion contagion: mice who saw their cage-mates suffer from stomach pains subsequently displayed higher pain sensitivity (Langford, Crager, Shehzad, Smith, Sotocinal, Levenstadt, Chanda, Levitin, & Mogil, 2006); mice showed physiological stress symptoms after hearing distress calls from conspecifics (Chen, Panksepp, & Lavis, 2009); mice who observed other mice getting shocked showed a freezing reaction (Jeon, Kim, Chetana, Jo, Ruley, Lin, Rabah, Kinet, & Shin, 2010). Moreover, other studies demonstrated that many animals also have prosocial behavior: Rats stopped pressing a lever when this caused another rat to receive an electric shock (Church, 1959), they pressed a lever when this brought down a distressed rat from a holster (Rice & Gainer, 1962), they even pushed a handle to pass food to another rat - especially if they had been helped before (Rutte & Taborsky, 2007). Even more complex is the prosocial behavior of primates: Monkeys stopped pulling a chain for food when this caused another monkey to receive an electrical shock, and in some cases starved themselves rather than pulling the chain (Masserman, Wechkin, Terris, 1964). In another study, chimpanzees showed helping behavior not only for conspecifics but also for human caregivers irrespective of being rewarded (Warneken, Hare, Melis, Hanus, & Tomasello, 2007). All these studies show that animals, and among them especially primates, share crucial components of empathy with humans. However, humans have the most developed empathy abilities. Examples of the higher order empathic abilities include being able to have empathy not only in an acute situation but also when imagining situations and being able to have empathy with all sorts of animals and even plants. Such highly developed

empathy may have also contributed to (or has co-evolved with) human's derivative talents of language, symbolism and abstract thought.

#### **1.1.4 Empathy, Personal Distress and Pro-social Helping Behavior**

One of the most interesting questions when discussing empathy is whether higher levels of empathy in cognitive or affective components measured by questionnaires or tests always translates to more behavior expressing these empathic attitudes and emotions in a pro-social manner. In regard to this question, Batson developed a model which proposes two pathways (Batson et al., 1987; see Figure 1):

1. First, if one feels empathy when seeing someone else in distress the likelihood of having an altruistic motivation to reduce the other's distress and displaying pro-social helping behavior increases. In the Batson Scale (Batson et al., 1987), empathy is characterized by the adjectives sympathetic, moved, compassionate, tender, warm, softhearted.

2. Second, if one feels personal distress when seeing someone else in distress the likelihood of having an egoistic motivation to reduce one's own distress and therefore not to display prosocial helping behavior (or only displaying helping behavior with the ultimate goal to decrease one's own and not the other's distress) increases. In the Batson Scale (Batson et al., 1987), personal distress is characterized by adjectives such as alarmed, grieved, upset, worried, disturbed, perturbed, distressed, troubled.

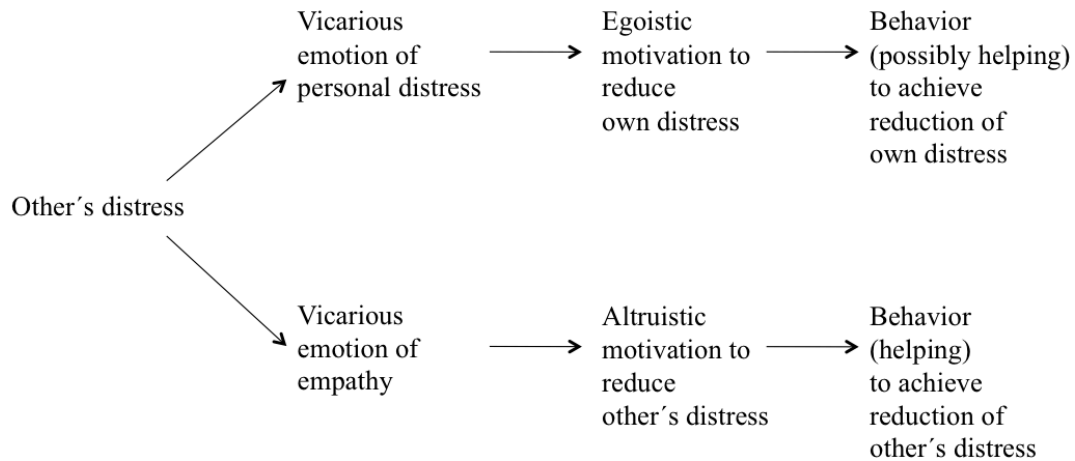


Figure 1. Batson's model explaining the relationship between empathy, personal distress and helping behavior. From "Empathy and Distress", by C. D. Batson, J. Fultz and P. A. Schoenrade, 1987, *Journal of Personality*, 55-1, p. 25. Reprinted with first author's permission.

Several points in regard to this model need to be considered. First, this model heavily leans on McDougall's view that qualitative distinctions between emotions exist and that they evoke different goals and motivations (Batson et al., 1987). However, there are other views. For instance, while Batson et al. (1987) argued that you may want to reduce the distress of a person in need, Hume assumed that seeing someone else in distress leads to a more general emotional state of arousal with the ultimate goal always being to reduce one's own arousal and not to with the ultimate goal to reduce the other's arousal (Chismar, 1988). Nonetheless, Batson's model is supported by empirical evidence and therefore seems to be to most broadly accepted. Secondly, Batson et al. (1987) stress that the questions Batson's model attempts to address "concern the nature of the motivation to help associated with individual differences - whether naturally occurring or induced by experimental manipulation - in empathic emotion in a particular situation, not with individual differences in dispositional empathy" (Batson et al., 1987, p. 21). Third, it is highly discussed as to what extent a motivation or behavior can be called altruistic if their effect is a reward such as money, (self-) respect or escape of censure. Batson et al. (1987) draw the line by proposing that as long as the effects are not ultimate goals but merely the consequences of behavior, then the motivation is still altruistic (Batson et al., 1987).

### **1.1.5 Bottom-up and Top-Down Processes of Empathy**

The definitions, theories and models that have been explained so far involve both bottom-up processes (i.e. sensory and perceptual driven) and top-down processes (i.e. cognitive and regulatory driven). For instance, the processes of mimicry and emotion contagion function in a bottom-up framework, while processes of perspective-taking and prosocial helping behavior function in a top-down framework. Jean Decety's model of empathy strives towards forging together these bottom-up and top-down processes by drawing on developmental neuroscience and explaining three levels of empathy: "(1) affective arousal, a bottom-up process grounded in perception-action coupling in which the amygdala, hypothalamus and orbitofrontal cortex (OFC) underlie rapid and prioritized processing of the emotional signal; (2) emotion understanding, which relies on self- and other-awareness and involves the medial prefrontal cortex (mPFC), ventromedial prefrontal cortex (vm)PFC and temporoparietal junction (TPJ), and; (3) emotion regulation, which depends on executive functions instantiated in the intrinsic corticocortical connections of the OFC, mPFC and dorsolateral (dl)PFC, as well as on connections with subcortical limbic structures implicated in processing emotional information" (Decety, 2010, p. 260). This model is supported by a number of studies which invent very thoughtful experimental designs for infants in order to explore the question of when empathy begins to develop. One of the most interesting is a study by Martin and Clark (1987) which assessed whether babies of a mean age of only 18.3 hours cried when listening to audiotapes of recorded crying vocalizations. The results showed not only that babies started to cry heavily when listening to the audio tapes, but also that they cried significantly more when listening to cries of babies their own age than when listening to babies of 11 months or when listening to baby chimpanzees. These results can be interpreted in the way that babies already show emotion contagion only hours after being born. Another interesting study with 18- and 25-months-olds was conducted by Vaish, Carpenter and Tomasello (2009): According to their results, when toddlers observed one adult harming another adult by taking away possessions, the toddlers showed concern and even prosocial behavior towards the victim. However, Decety

argues that it is most important that empathy gradually develops as part of the development of emotions and that one can really only speak of empathy as a higher-order emotion at around the second and third years of life, when self-awareness and the ability to differentiate between oneself and others is at a more pronounced state due to the development of the prefrontal cortex (Decety, 2010). One could also relate Decety's model and its developmental aspects of empathy and their related brain regions to an evolutionary perspective: Some conclusions one may draw would be that the development of the different levels of empathy – with “affective arousal” being given at birth and the “emotional understanding” and “emotional regulation” arising at around three to six months and continually developing into adulthood – aligns with the evolutionary age of the related brain regions which Paul MacLean (1990) describes relatively easily with his model of the triune brain that explains the brain stem and the cerebellum as the very old “reptilian brain”, the limbic system as the “old mammalian brain” and the neocortex as the brain with higher executive functions.

## **1.2 Neuroscience of Empathy**

### **1.2.1 Paradigm “Empathy for Pain”**

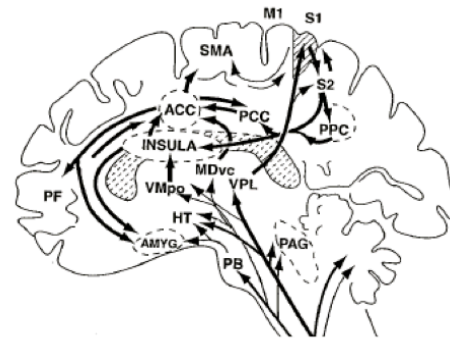
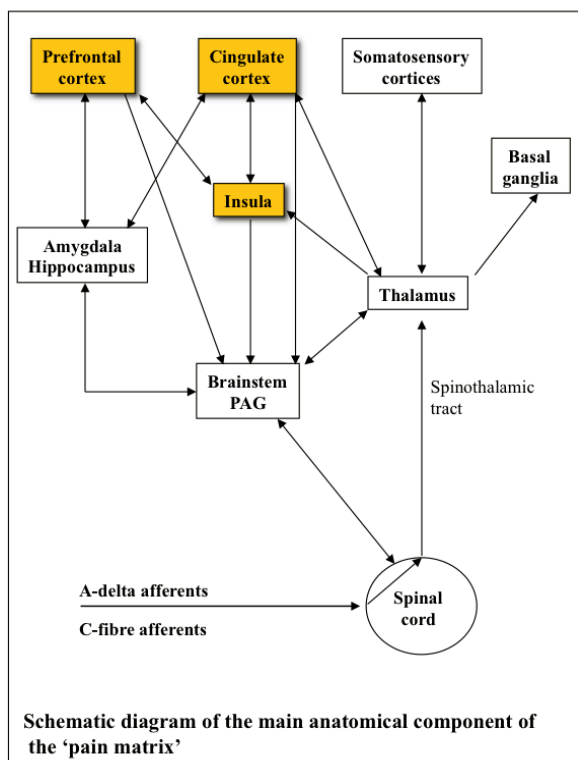
There are many ways to measure empathy. In the field of social neuroscience (Cacioppo & Bemtson, 1992), empathy is often measured by recording reactions to observing others in pain. The paradigm empathy for pain tests that the same neural representations become activated both when observing others in pain and when experiencing pain one’s self. The perception-action model of empathy says that “The attended perception of the object’s state automatically activates the subject’s representation of the state, situation, and object, and the activation of these representations automatically primes or generates the associated autonomic and somatic responses, unless inhibited” (Preston & de-Waal, 2000, p. 4). Indeed, the existence of single neurons in the Anterior Cingulate Cortex (ACC) which become activated during both the sensation and perception of pain has been revealed (Hutchinson, Davis, Lozano, Tasker & Dostrovsky, 1999). Moreover, a correlation was found between trait empathy as measured by self-report questionnaire scores and the degree to which the ACC and the Anterior Insula (AI) become activated during the sensation and perception of pain (Singer, Seymour, O’Doherty, Kaube, Dolan & Frith, 2004). These findings are thought to provide the neural mechanisms for the link between direct pain perception and interpreting the observation of others in pain and therefore for the phenomenon of “empathy for pain”.

### **1.2.2 Pain Matrix**

Decety and Lamm (2009) have provided a detailed categorization system for brain regions involved in empathy which they call the “Pain Matrix” (see figure 2). This schematic representation highlights that there is no single brain region where the ability to empathize originates, but a number of brain regions, and the complex



connections between them, create the ability of empathy. Many studies have contributed to the realization of Decety's and Lamm's (2009) pain matrix: Initially, studies such as the ones from Singer et al. (2004) or Jackson, Meltzoff and Decety (2005) indicated significant activation during the observation of pain in the anterior cingulate cortex (ACC), medial cingulate cortex (MCC) and the anterior insula (AI). However, recently Avenanti, Buetti, Galati, Aglioti (2005) also found significant activation during pain observation in the sensorimotor cortex. Hence, Decety and Lamm (2009) concluded that the ACC and the insula represent the affective and motivational aspects of pain - such as emotional evaluation of the stimuli and preparation of a response, while the primary somatosensory cortex (S1) and the secondary somatosensory cortex (S2) represent sensory aspects of pain - such as discrimination of the location and intensity of the stimulus (see Figure 2).



- ➔ **The primary (S1) and secondary (S2) sensory cortices** are involved in the sensory-discriminative aspects of pain, e.g., the bodily location and intensity of the stimulus.
- ➔ **ACC and insula** subserve the affective-motivational component, i.e., the evaluation of subjective discomfort and response preparation in the context of painful or aversive stimuli.

Figure 2. Decety's and Lamm's categorization system for brain regions involved in empathy called "pain matrix". The yellow fields denote areas playing a primary role for empathy. From "Empathy versus Personal Distress", by J. Decety and C. Lamm, 2009, in Ickes and Decety, 2009, p. 202. Reprinted with second author's permission.

It is crucial to stress some significant aspects when discussing this model. First, the overlap of brain regions that become significantly activated when observing someone in pain and when being in pain oneself is far from complete (Jackson, Rainville & Decety, 2006). Second, “vicariously instigated activations in the pain matrix are not necessarily specific to the emotional experience of pain; they may be shared by other processes such as somatic monitoring, negative stimulus evaluation, and the selection of appropriate musculoskeletal movements of aversions” (Decety & Lamm, 2009, p. 202).

### **1.2.3 Affective, Motor and Somatosensory Components of Empathy**

Bastiaansen, Thioux and Keysers (2009) suggest one should categorize affective, (sensory-) motor and somatosensory components of the pain matrix (see figure 3). Affective components are often assessed with functional magnetic resonance imaging (fMRI), motor components with transcranial magnetic stimulation (TMS) and somatosensory components with magnetoencephalography (MEG) or electroencephalography (EEG). Two intricacies related to this separation into different components of empathy need to be pointed out. First, one should not assume, since many studies mainly focus on one of these components, that these brain areas do not interact during the experience and observation of pain. For example, using MEG Betti, Zappasodi, Rossini, Aglioti and Tecchio (2009) demonstrated that band coherence values signaling crosstalk between sensory and motor cortices significantly increased when watching videos of hands being painfully penetrated by a needle as compared to watching hands being touched or at rest. Similarly, Han, Fan, Xu, Quin, Wu, Wang, Aglioti and Mao (2009) inferred interactions between affective and somatosensory components because their results showed that when watching painful stimuli in an emotional context, affective responses decrease while somatosensory responses increase. Second, although affective components are often assessed with fMRI, motor components with TMS,

and somatosensory components with MEG or EEG, it can be of value to employ other neuroscientific measures in order to validate findings about specific components of empathy for pain.

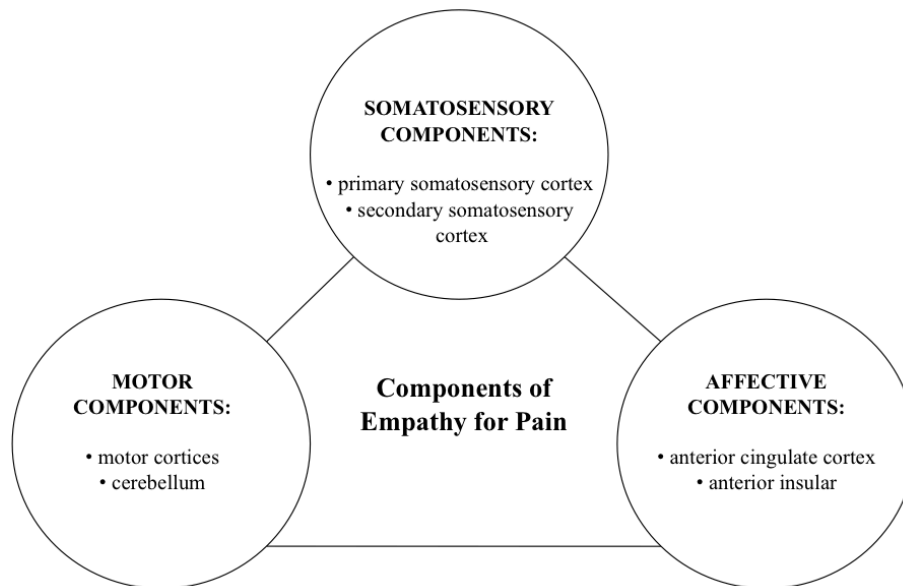


Figure 3. Schematic representation of affective, motor and somatosensory components, derived from Baastiansen et al.'s (2009) review.

### **Affective Components of Empathy**

Affective components of empathy for pain are the ACC, more specifically the posterior ACC, the anterior MCC and the anterior insula (reviewed in Singer & Lamm, 2009), which are most commonly and directly assessed with fMRI. Singer et al. (2004) used fMRI to compare brain activity when participants received painful stimuli and when participants observed a signal indicating that their partner, present in the same room, was experiencing a painful stimulation. In both conditions the bilateral anterior insula and the rostral cingulate cortex were activated. Recent studies especially try to analyze intra- and interpersonal as well as situational influences on the activity of the ACC and the AI when observing others in pain. For instance, Lamm, Meltzoff and Decety (2010) assessed how participants empathized with people who are not like the norm – referring to patients who responded with no pain to surgical procedures and with pain to touch. Results of the fMRI showed that

whether or not people respond to pain in the way oneself does, when observing them in pain the ACC, MCC and the anterior insula were activated. However, when observing patients, the dorsomedial prefrontal cortex, which is associated with self-other distinction, and the right inferior frontal cortex, which is associated with cognitive control, were also activated - suggesting executive functions regulating affective responses when observing people who are not like oneself.

### **Motor Components of Empathy**

Motor components of empathy for pain are the motor cortices and the cerebellum which are most commonly assessed with TMS, as well as EEG. Avenanti et al. (2005) used TMS to record changes in corticospinal motor representations when observing needles painfully penetrating hands or feet. They found a reduction of motor-evoked potentials (MEPs) which was specific to the observed penetrated muscle. This inhibition correlated with the intensity of pain ascribed to the observed person, was increased in participants with high trait cognitive empathy, and decreased in participants with high trait personal distress (Avenanti, Minio-Paluello, Bufalari & Aglioto, 2009).

### **Somatosensory Components of Empathy**

Somatosensory components of empathy for pain are the somatosensory cortex I (SI), the somatosensory cortex II (SII), the (posterior) insular cortex and the thalamus (Price, 2000) which are most commonly assessed with EEG and MEG, but also with fMRI. Keysers, Wicker, Gazzola, Anton, Fogassi and Gallese (2004) found that both when being touched and when observing someone or something else being touched by objects resulted in fMRI activation of the SII but not SI. In contrast, Jackson et al. (2005) failed to find activation in SI and SII in their study using fMRI. Bastiaansen, et al. (2009) argue that the reason that about half of fMRI studies found activity in the SI and the SII and half did not, is that besides problems with sample size, experimental design and analysis, it could simply be the case that fMRI is not

sensitive enough of a method to measure the very early occurring activation in SI and SII. In line with this, Lamm, Decety and Singer (2011) found in a meta-analysis that only picture-based paradigms (which describe visual displays of others in painful situations) but not cue-based paradigms (which describe cues that signal the participant that oneself or a nearby target person is receiving a painful stimulation) activated somatosensory areas.

However, several EEG studies which employed different methods and smart experimental designs successfully revealed somatosensory resonance during empathy for pain. For example, using EEG, Bufalari, Aprile, Avenanti, Di Russo and Aglioti (2007) measured somatosensory evoked potentials (SEPs) by non-painful electrical stimulation of the right median nerve at the wrist while participants watched videos of hands being penetrated by a needle, hands being touched by a Q-tip, or hands not being stimulated. Their results demonstrated that the P45, a positive component, which occurs about 45 ms after the electrical stimulation and reflects the activity of SI, increased when observing others in pain and decreased when observing others being touched. Also, using MEG Cheng et al. (2008) were able to look at somatosensory oscillations by non-painfully stimulating the left median nerve. The quantified post-stimulus rebounds of the 10 Hz somatosensory oscillations were more suppressed when observing pictures of painful situations than when observing pictures of non-painful situations. The next chapter will describe the rather new method of event-related desynchronization when measuring somatosensory desynchronization during empathy for pain.

#### **1.2.4 Somatosensory Event-Related Desynchronization (ERD) and Synchronization (ERS) during Empathy for Pain**

Since the analysis of somatosensory desynchronization by the event-related desynchronization method (Pfurtscheller & Aranibar, 1977) is employed for the experiment of this thesis, it is introduced here in more detail:

“Brief somatosensory stimuli are followed by amplitude decreases (event-related desynchronization, ERD) of the 10 and 20 Hz oscillations over the bilateral primary sensorimotor cortices, and by poststimulus synchronization (event-related synchronization, ERS) of the 20 Hz oscillations in the contralateral primary sensorimotor cortex and in the supplementary motor area (SMA)” (Stancák, 2006, p.237).

In line with his experimental results, Stancák (2006) states that the 10 Hz and 20 Hz ERD distinguishes between painful and not painful somatosensory stimuli. He proposes that the post-stimulus 20 Hz ERS is likely to represent an inhibition of the motor cortex. Interestingly, he also points out that stimulation of different fingers produces somatosensory ERD showing a somatotopic organization. However, he also highlights that increased stimulation causes habituation and decreased ERD and ERS. Most importantly, Stancák (2006) concludes that since somatosensory ERD and ERS are easily influenced by cognitive processes such as anticipation, action viewing and imagination, they resemble top-down rather than bottom up cortical processes and should be attributed to preparedness in particular somatosensory channels.

Whitmarsh et al. (2011) compared the three studies that have analyzed ERD and ERS in response to somatosensory pain stimuli without any electrical stimulation on body parts of the participants - one was by Mu, Fan, Mao and Han (2008), one by Yang, Decety, Lee, Chen and Cheng (2008) and one by Perry, Bentin, Bartal, Lamm and

Decety (2010). They concluded several important intricacies one has to pay attention to when designing experiments measuring somatosensory desynchronization during empathy for pain (see Table 1):

1. Whitmarsh et al. (2011) suggest that one reason Mu et al. (2008) found reduced alpha suppression (see table 1) but Yang et al (2008) and Perry et al (2010) found increased alpha suppression is that “volume conduction makes it difficult to separate sensorimotor alpha (or mu-rhythm) from posterior alpha sources in EEG scalp recordings” (Whitmarsh, 2006, p. 2).
2. Whitmarsh et al. (2011) criticize that Yang et al. (2008) and Perry et al. (2010) analyzed time windows that might have been confounded by stimulus-onset evoked responses because both calculated alpha suppression with time intervals starting at stimulus onset. Whitmarsh et al. (2011) point out that they believe one should analyze alpha suppression for later time windows. Indeed Mu et al. (2008) performed analyses for separate time windows and found that alpha suppression is modulated only between 200 and 400 ms after stimulus onset - which, however, might have still been confounded by transients of stimulus offset because their pictures were only presented for 200 ms (see table 1).
3. Whitmarsh et al. (2010) assume that Mu et al.’s (2008) results might have been confounded by an interaction between somatosensory desynchronization and a certain motor-preparation which was likely to come from the participants task to evaluate every stimulus.

Whitmarsh (2011) et al conducted a study which addressed all the shortcomings of these three studies: They used MEG and a beamformer technique allowing source localization, they restricted their statistical analyses to the non-evoked period 400 ms after stimulus onset, and their participants watched pain stimuli in a passive way that required no motor responses. Whitmarsh et al.’s (2011) results showed an increased alpha suppression being in line with Yang et al.’s (2008) and Perry et al.’s (2010) results, but contradicting Mu et al. (2008), (see Table 1).

Table 1

*Studies analyzing Alpha Desynchronization during Empathy for Pain without employing Electrical Somatosensory Stimulation*

Study	Stimuli	Analysis	Results
Mu, Fan, Mao & Han, 2008	800-1600 ms fixation cross (baseline)  200 ms picture (conditions)	Time-Frequency Analysis comparing 200 ms pre-stimulus (baseline) to five consecutive time windows of 200 ms from 0-1000 ms post-stimulus (conditions)	Less alpha (9-11 Hz) suppression at 200-400 ms (frontal, central),
Yang, Decety, Lee, Chen & Cheng, 2008	300 -600 ms fixation cross (baseline)  1400-1700 ms picture (conditions)	Time-Frequency Analysis comparing 200 ms pre-stimulus (baseline) to 0-1300 ms post-stimulus (conditions)	More alpha (8-13 Hz) suppression (central)
Perry, Bentin, Bartal, Lamm & Decety, 2010	2000 ms fixation cross (baseline)  2000 ms picture (conditions)	Time-Frequency Analysis comparing 500 ms pre-stimulus (baseline) to 0-2000 ms post-stimulus (conditions)	More alpha (8-12 Hz) suppression (frontal, central)
Whitmarsh, Nieuwenhuis, Barendregt & Jensen, 2011	1500 ms fixation cross (baseline)  1500 ms picture, (conditions)	Time-Frequency Analysis comparing 200 ms pre-stimulus (baseline) over whole post-stimulus interval (conditions), but restricted statistical analysis to non-evoked period (>400 ms)	More alpha (7-14 Hz) suppression at > 400 ms (central)

Note. While Mu et al. (2008) found less alpha suppression during empathy for pain, Yang et al. (2008), Perry et al. (2010) as well as Whitmarsh et al. (2011) found more alpha suppression during empathy for pain. I created this table for the purpose of this thesis.



## **1.3 Empathy, Racial Group Membership and Familiarity**

### **1.3.1 Relationship between Empathy and Racial Bias**

The aim of this thesis is not only to explore intricacies of somatosensory resonance during empathy for pain, but also how this might be modulated by factors such as racial bias or familiarity with the target being in pain. Before going into detail and discussing specific studies which have assessed racial bias modulating affective and motor components of empathy for pain, it is necessary to define racial bias. Surprisingly, no unrestrictedly accepted definition of racial bias exists in the social psychology literature. Greenwald, McGee and Schwartz (1998) define racial bias in the context of their Implicit Association Task: They describe most people, including those with black-colored skin, as having an implicit bias to favor white-colored people - measured as stronger associations between White faces and positive words or associations between Black faces and negative words, and weaker associations between White faces and negative words or associations between Black faces and positive words. Similarly, the widely established social-psychological cross-race effect or cross-race bias (Meissner & Brigham, 2001) proposes a better recognition and processing of faces that belong to one's own race as compared to faces that belong to other races. Hence, a generalization of these paradigms would be that racial bias can be defined as more positive and enhanced reactions to members of one's own race as compared to members of other races.

Many explanations for *why* one can have a racial bias have been found in the last decades. In his pioneering work "The Nature of Prejudice" of 1954 Allport proposes the theory that racial bias can be explained through the general phenomenon of group membership. He defines an 'in-group' as "any cluster of people who can use the term 'we' with the same significance" (Allport, 1954, p. 37). One can belong to many in-groups, for instance: one's family, one's neighborhood, one's city, one's state, one's

nation, one's racial stock or mankind in general. Allport concludes, the larger the circle of inclusion, the fewer personal contact and the in-group potency of membership (Allport, 1954). Allport also philosophizes about the nature of out-groups. He says "every line, fence, or boundary marks off an inside from an outside. Therefore, in strict logic, an in-group always implies the existence of some corresponding out-group. But this logical statement by itself is of little significance. What we need to know is whether one's loyalty to the in-group automatically implies disloyalty, or hostility, or other forms of negativism, towards out-groups" (Allport, 1954, p. 41). Pettigrew responded with his article "The Ultimate Attribution Error: Extending Allport's Cognitive Analysis of Prejudice" (Pettigrew, 1979): He hypothesized that one is more likely to attribute a negative act by an out-group member as compared to a negative act by an in-group member dispositionally rather than caused by the situational context. Whereas, a positive act by an out-group member as compared to the same act by an in-group member is more likely to be attributed to "(a) the exceptional case, (b) luck or special advantage, (c) high motivation and effort, (d) manipulable situational context" (Pettigrew, 1979, p. 461). Hence, group membership seems to lead to positivism towards one's in-group and negativism towards one's out-group. A logical deduction is that one has more empathy for in-group members as compared to out-group members because one experiences more favoritism and identification with one's in-group while having developed a more negative attitude towards out-groups.

A relationship between empathy and group membership also makes sense when reminding oneself about the evolutionary perspective. As outlined in "1.1.3 Evolutionary Functions of Empathy" of this thesis, being able to understand the emotions of others by empathizing allows oneself to live in social groups and benefit from the evolutionary advantages that this brings with it - such as being safer from predators and danger, being cared for from birth by other members of the group and having rewarding emotions of affiliation and love for others. Hence, one also might assume that in the past having a racial bias also had the evolutionary advantage of being cared for by one's own social group and protected against other rival groups.

In fact, more recent articles support Allport and Pettigrew's ideas about there being more favoritism for in-groups than for out-groups. For instance, Krill and Platek (2009) found that participants show greater ACC activation and express greater distress for social exclusion by same-race faces relative to other-race faces. This also explains why Yabar et al. (2006) measured increased patterns of mimicry when non-Christians observed faces of non-Christians than when they observed faces of Christians, which implies that one tries to affiliate more with in-group members, possibly in order to strengthen social bonds within one's in-group. The extent to which the general phenomenon of group membership is able to moderate empathy for in-group and out-group members can be seen when looking at a study by Stürmer et al. (2006). They proposed an 'empathy x group moderation hypothesis' and assessed whether participants showed greater helping intentions when the target was categorized as an in-group member and not an out-group member. In fact, they found that German and Muslim students were more inclined to help an in-group member with an apartment search than to help an out-group member. What was most surprising though was that they replicated their experiment employing not the culturally clearly defined groups of Germans and Muslims but employing merely laboratory-created groups of 'detailed' or 'global' perceivers in a random dot-estimation task. Even though all participants were assigned to the group of detailed perceivers and had no contact with other members of this seemingly unimportant group, they again displayed greater distress and helping behavior for in-group members than for out-group members. If one already shows greater empathy for such meaningless and fictitious groups, it becomes clear that racial group membership modulating empathy is even more possible.

### **1.3.2 Racial Group Membership modulating Affective and Motor Components of Empathy for Pain**

So far, to our knowledge, it has only been investigated whether racial bias modulates affective or (sensori-) motor components of empathy for pain but not whether it also modulates somatosensory components.

The one study which has assessed racial bias modulating affective components of empathy for pain has been conducted by Xu et al. (2009). They demonstrated that racial group membership modulates empathic neural responses. The activation in the ACC, when Caucasians and Chinese watched video clips of faces being painfully pricked by needles, was significantly lower when observing faces of other races as compared to faces of one's own race.

Several studies have assessed racial bias modulating (sensori-) motor components of empathy. Avenanti et al. (2010) found an inhibition of MEPs for both Black and White participants only when observing hands of in-group members but not of out-group members being penetrated by needles. This effect correlated with the implicit racial bias measured by the Implicit Association Test (IAT) by Greenwald et al. (1998). In a similar study Gutsell and Inzlicht (2010) showed by recording mu rhythms measured with EEG that participants displayed activity over the motor cortex when watching in-group members reach for a glass and when performing the same action oneself, but not when observing out-group members. This effect correlated with the symbolic racism scale (SRS) by Henry and Sears (2002), an explicit measurement for racial bias.

### **1.3.3 Relationship between Empathy, Racial Group Membership and Familiarity**

Avenanti et al. (2010) correctly pointed out that when studying the relationship between empathy and racial bias, one also has to consider the factor of familiarity as a possible moderator variable. Avenanti et al. (2010) argued that the lesser empathic neural response for out-groups than for in-groups might not be caused by racial bias but could also simply stem from less familiarity with out-groups. This hypothesis is based on the “mere exposure effect” by Zajonc (1968) which proposes that one tends to favor symbols, objects or people over others simply because one has had more exposure to them and therefore is more familiar with them. For example, in a typical mere exposure experiment, participants show higher ratings of familiarity, recognition and preference for objects with higher exposure frequency (see Bornstein, 1989, for a meta-analysis).

In order to test their hypothesis Avenanti et al. (2010) came up with an extra-ordinary smart design including two experiments: In their first experiment, they presented their White and Black participants videos showing hands of racial in- and out-group members which were either penetrated by a needle (*pain* condition) or merely touched a Q-tip (*touch* condition). The results demonstrated that the MEP amplitude (calculated by subtracting the *touch* condition from the *pain* condition) was positive for out-group members and negative for in-group members. This indicates higher empathic sensori-motor contagion for in-groups than for out-groups and therefore suggests that racial bias modulates motor components of empathy. However, this result did not control for the factor of familiarity which could be a possible moderator variable of the relationship between empathy and racial bias. Hence, in their second experiment, they created a third group of stimuli consisting of videos in which the hands from the first experiment were digitally colored violet. The results of how familiar participants judged the stimuli showed that indeed the violet stimuli were judged as very unfamiliar (Figure 4a). In other words, this means that their experimental manipulation has worked. Interestingly, participant’s judgments showed

that they are almost equally familiar with stimuli showing in-groups or out-groups (Figure 4a). One could conclude that this behavioral result alone is proof enough that the factor of familiarity does not play a role for the main research question. However, participants can easily lie in behavioral designs. Only the inclusion of a third group allows a conclusion in neuroscientific designs. As the results showed, the MEP amplitude was the most suppressed for the racial in-group, followed by the violet out-group, followed by the racial out-group (Figure 4b). Therefore, unfamiliarity cannot be the only factor causing the low MEP amplitude for the racial out-group; racial bias also contributes to the overall effect.

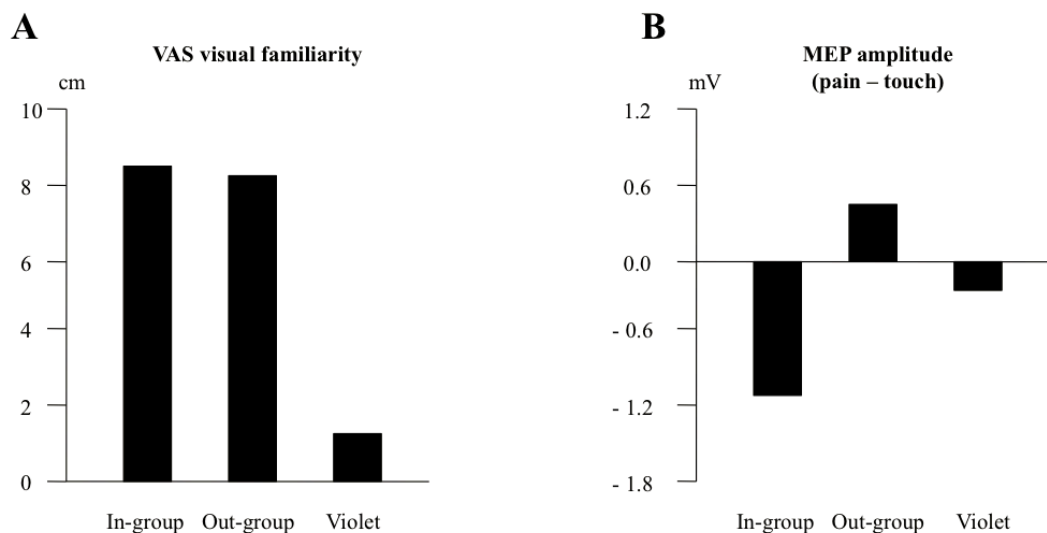


Figure 4. Results from Avenanti et al.'s (2010) study.

(A) Subjective ratings (visual analog scale, VAS) of visual familiarity of the observed hand with respect to one's own hand.

(B) MEP difference (pain - touch) in the subgroup of onlookers tested during observation of in-group, out-group, and extremely unfamiliar violet models, recorded in the target FDI muscle.

From "Racial Bias Reduces Empathic Sensorimotor Resonance with Other-Race Pain", by Avenanti et al., 2010, p. 1021. Reprinted with the first author's permission.

As one might notice from Avenanti et al.'s (2010) results, it cannot be concluded to what extent racial bias and to what extent familiarity caused the MEP amplitude for

the racial out-group to be lower. This is mostly so because one cannot defend the assumption that the effect of racial bias and familiarity on empathy for pain are independent from each other. In other words, apart from the effect of racial bias on empathy and the effect of familiarity on empathy, there might also be an interaction between familiarity and racial bias. In what way racial bias and familiarity interact is not clear: One could argue that more familiarity and contact with a racial out-group decreases racial bias, but it could just as much enhance racial bias. In conclusion, more research is needed to disentangle the relationship between racial bias and familiarity. Nonetheless, Avenanti et al. (2010) were able to show that the results from their first experiment, claiming that motor components of empathy for pain are modulated by racial bias, were supported by the results of their second experiment, which demonstrated that the changes in MEP amplitudes were not only caused by familiarity, but racial bias as well.

On a different note, when assessing the relationship between racial bias and familiarity, one must also always keep in mind in what country the experiment takes place. Many experiments on stereotypes and prejudice against Black Americans are conducted in the United States of America in which the population of Black residents made up 13.6 percent of the total population in 2009 (United States Census Bureau of the American government). In Italy - where Avenanti et al. (2010) conducted their study - Black residents only made up approximately 1.53 percent of the total population in 2009 (Italian National Institute of Statistics). In Austria - where the experiment of this thesis was conducted - Black residents made up only about 0.5 percent of the total population in 2010 (Annual report about Black people in Austria). Depending on how big the percentage of a group in one country is, surely the familiarity with members of that group varies for the rest of the population. Of course, other factors such as the national history of racism or current immigration and integration policies also matter. In conclusion, conducting experiments about stereotypes, prejudice and discrimination in as many countries as possible is important, but one has to be careful to not generalize results without also assessing the factor of familiarity.





## **EMPIRICAL PART**



## **2. DESIGN**



## **2. DESIGN**

### **2.1. Research Question**

The research question for this thesis is the following: “Is alpha desynchronization during empathy for pain modulated by racial group membership?” Three aspects explaining the motivation to investigate this research question are worth pointing out:

1. Although studies have assessed whether racial bias modulates affective components of empathy for pain measured with fMRI (Xu et al., 2009) and motor components of empathy for pain measured with TMS (Avenanti et al., 2010), to our knowledge no study has yet assessed whether racial bias modulates somatosensory components during empathy for pain. We argue that the alpha desynchronization we measure with EEG can be interpreted as somatosensory alpha desynchronization, because our pain stimuli are somatosensory in their nature, because we mainly find somatosensory desynchronization in a time interval in which no motion is present in our stimuli and because other research from our field also defend interpretations of suppressed somatosensory oscillations and somatosensory desynchronization (Stancák, 2006; Cheng et al., 2008; Whitmarsh, et al., 2011).
2. Moreover, we intend to explore the relationship between empathy, racial bias and familiarity on a wider scope than it was ever researched before: We assess three levels with EEG measurements, with questionnaires as well as with behavioral experiments.
3. Finally, we employ a state of the art EEG analysis - namely time frequency analysis assessing alpha desynchronization. In doing so, we also mind Whitmarsh et al.'s (2011) findings and therefore our participants watch pain stimuli in a passive way that requires no motor responses, and we analyze two different time intervals post-stimulus.

## **2.2 Dependent and Independent Variables**

In order to address the research question, two EEG sessions were held. During the first EEG session White participants watched videos of White and Black hands either being penetrated by a needle or being slightly touched by a Q-tip, while during the second EEG session White participants watched videos of violet colored White and violet colored Black hands being penetrated by a needle or being slightly touched by a Q-tip. Why we included violet colored hands as a third stimuli group is explained in great detail in the chapter 1.4 “Empathy, Racial Bias and Familiarity”; in short: By including a group of stimuli such as very unfamiliar violet colored hands one is able to control whether participants showed more alpha desynchronization during empathy for pain for racial in-group members than for out-group members because they indeed have a racial bias and not because they only have less familiarity with racial out-group members.

Our design differs slightly from Avenanti et al.’s (2010) design in the numbers of participants being employed for each of the two sessions. Avenanti et al. (2010) tested 18 Caucasian and 18 Black participants in the first session showing White and Black hands. For the second session, showing violet colored White and violet colored Black hands, they invited eight participants from the first session to again come to their laboratory. We think that the participants from Avenanti et al.’s (2010) study might have been able to guess that the hands from the second session merely are the violet colored White and Black hands from the first session which would make the experimental manipulation of creating a truly new and unfamiliar violet group of stimuli questionable. Therefore, we opted for a design in which different participants are tested in the first and second session. Further discussions about preferable large group sizes resulted in the decision that we would rather test a large sample of White participants than two smaller samples of White and Black participants. Hence, we tested 37 White participants during the first session and 32 White participants during the second session.

Hence, the dependent and independent variables of the EEG experiment are as follows (see Table 2):

- The dependent variable is constituted by alpha desynchronization (operationalized by ERD measured in the alpha range of 7 – 14 Hz).
- The first independent within-subject variable “empathy for pain” is subdivided in the two categories *pain* (operationalized by videos of hands being penetrated by a needle) and *no pain* (operationalized by videos of hands being touched by a Q-tip).
- The second independent within-subject variable “race” is subdivided in the two categories *White* (operationalized by videos of hands from White people) and *Black* (operationalized by videos of hands from Black people).

The between-subject variable “familiarity” is subdivided in the two categories familiar *original colored* (operationalized by videos of hands of White and Black people shown in their actual color, collected in the first session) and unfamiliar *violet colored* (operationalized by videos of hands of White and Black people colored in violet, from the second session).

Table 2  
*Eight Experimental Conditions for the Three Factors Empathy for Pain, Race and Familiarity*

Familiarity	White		Black	
	Pain	No Pain	Pain	No Pain
Original Color	1 <sup>st</sup> Condition	2 <sup>nd</sup> Condition	3 <sup>rd</sup> Condition	4 <sup>th</sup> Condition
Violet Color	5 <sup>th</sup> Condition	6 <sup>th</sup> Condition	7 <sup>th</sup> Condition	8 <sup>th</sup> Condition

Note. The within-subject factor “empathy for pain” is subdivided in the two categories *pain* and *no pain*, the within-subject factor “race” is subdivided in the two categories *White* and *Black*, the between-subject factor “familiarity” is subdivided in the two categories *original colored* and *violet colored*.

Furthermore, similar to Perry et al. (2010) we determined twelve regions of interest (ROIs) analyzing only data from electrodes that fell into these regions (see Figure 5). This scheme leads to two more variables which have to be regarded during the statistical analysis:

- The independent within-subject variable “area” is subdivided in the four categories *frontal* (operationalized by electrodes over the frontal region), *central* (operationalized by electrodes over the central region), *parietal* (operationalized by electrodes over the parietal region) and *occipital* (operationalized by electrodes over the occipital region).
- The independent within-subject variable “side” is subdivided in the three categories *left* (operationalized by electrodes over the left hemisphere), *middle* (operationalized by electrodes on the central side) and *right* (operationalized by electrodes over the right hemisphere).

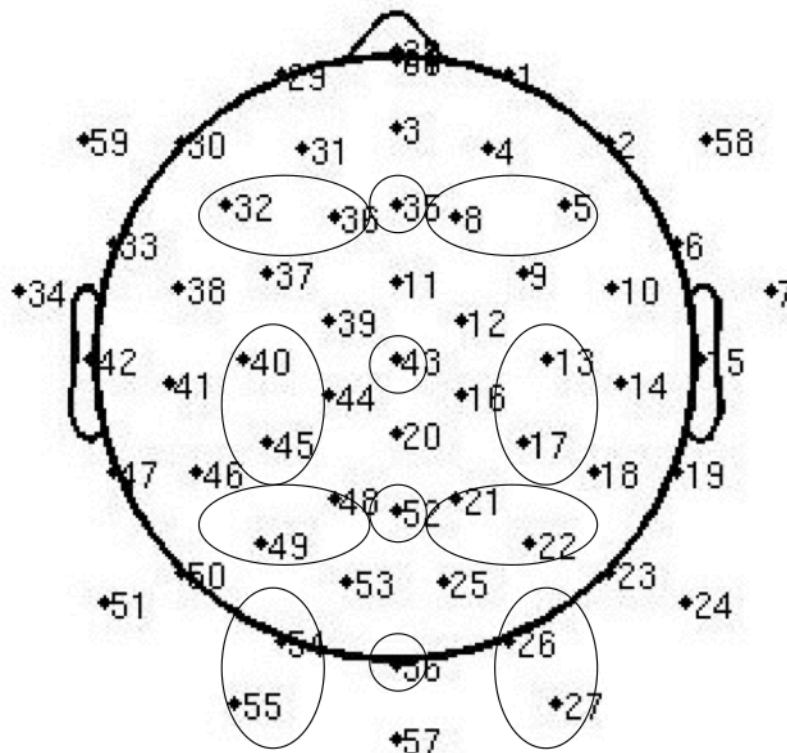


Figure 5. Twelve regions of interest from which data will be analyzed. This results in four areas (*frontal*, *central*, *parietal* and *occipital*) as well as three sides (*left*, *middle*, *right*) being assessed.



## **2.3 Hypotheses for Behavioral Measurements**

### **Hypothesis for Empathy for Pain of EEG Stimuli**

Participants were asked to rate the EEG stimuli in regard to how painful the situation was for the person whose hand was penetrated by a needle or touched by a Q-tip, and how unpleasant it was for them to watch the situation.

The first hypothesis (H1) is that the ratings of painfulness and unpleasantness are higher for *pain* than for *no pain*.

Since we assume that participants would be more aroused when observing a hand being penetrated by a needle than being touched by a Q-tip - independent of whether they observe *original colored White*, *original colored Black*, *violet colored White* or *violet colored Black* stimuli, the hypothesis is formulated as a directed hypothesis. This hypothesis has been supported by numerous studies investigating empathy for pain (for example Yang et al., 2008; Perry et al., 2010; Whitmarsh et al., 2011).

### **Hypothesis for Race of EEG Stimuli**

The second hypothesis (H2) is that the ratings of painfulness and unpleasantness are higher for *White* than for *Black*.

Since we assume that due to racial group membership White participants would be more aroused when observing *White* stimuli than when observing *Black* stimuli - independent of whether they observe *pain* or *no pain* stimuli, the hypothesis is formulated as a directed hypothesis. This difference should be found when looking at *original colored White* and *original colored Black* stimuli. When looking at *violet colored White* and *violet colored Black* stimuli the suppression should be similar.

## **Hypothesis for Empathy for Pain x Race Interaction of EEG Stimuli**

The third hypothesis (H3) is that the ratings of painfulness and unpleasantness are higher for *original colored White*, *violet colored White* and *violet colored Black* than for *original colored Black*.

According to Avenanti et al.'s (2010) results, White participants demonstrated higher ratings of painfulness and unpleasantness of the EEG stimuli for their racial in-group than for their racial out-group. If the factor of familiarity does not play a role for the interaction between empathy for pain and race, then White participants would show similar ratings for *original colored White*, *violet colored White* and *violet colored Black* but less for *original colored Black*.

## **2.4 Hypotheses for Correlations between Painfulness and Unpleasantness of EEG Stimuli**

### **Hypothesis for Correlation between Painfulness and Unpleasantness of EEG Stimuli and Prosocial Behavior**

For the ratings of painfulness and unpleasantness a score was calculated by subtracting the difference of *original or violet colored Black pain* minus *original or violet colored Black no pain* from the difference of *original or violet colored White pain* minus *original or violet colored White no pain*.

In response to a picture of an *original or violet colored White* and *original or violet colored Black* hand, participants were asked whether they would be willing to help prepare letters that would be sent out to gather donations for these patients. We assume that the measure of prosocial behavior should correlate with ratings of painfulness and unpleasantness of the EEG stimuli in a directed way.

The 4th hypothesis (H4) is that the higher the ratings of painfulness and unpleasantness (calculated by subtracting the difference of *original or violet colored Black pain* minus *original or violet colored Black no pain* from the difference of *original or violet colored White pain* minus *original or violet colored White no pain*), the higher prosocial behavior.

### **Hypothesis for Correlation between Painfulness and Unpleasantness of EEG Stimuli and Explicit Empathy**

A score for the ratings of painfulness and unpleasantness was calculated by subtract-

ing *no pain* from *pain*, because the paradigm empathy for pain is defined as the difference between *pain* and *no pain*.

The 5th hypothesis (H5) is that there is relationship between empathy for pain based on the ratings of painfulness and unpleasantness (calculated by subtracting *no pain* from *pain*) and one's explicit empathic traits (perspective taking abilities, one's ability to identify with others, one's empathic concern and one's personal distress when observing others in need).

The hypothesis is tested as a directed (one-tailed) hypothesis because as empathy for pain based on the ratings of painfulness and unpleasantness increases, so too should explicit empathy assessed by a questionnaire.

### **Hypothesis for Correlation between Painfulness and Unpleasantness of EEG Stimuli and Implicit and Explicit Racial Bias**

A racial bias score for empathy for pain based on the ratings of painfulness and unpleasantness was calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*.

The 6th hypothesis (H6) is that there is a relationship between the racial bias based on ratings of painfulness and unpleasantness of the EEG stimuli (calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*) and implicit and explicit racial bias.

As the racial bias based on ratings of painfulness and unpleasantness of the EEG stimuli increases, implicit and explicit racial bias should as well. This is why the hypothesis is tested as a directed (one-tailed) hypothesis.

### **Hypothesis for Correlation between Painfulness and Unpleasantness of EEG Stimuli and Familiarity**

The 7th hypothesis (H7) is that there is a relationship between the racial bias based on ratings of painfulness and unpleasantness of the EEG stimuli (calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*) and explicit familiarity.

The hypothesis is tested as an undirected (two-tailed) hypothesis because familiarity with Blacks could be related to an increased or decreased racial bias based on ratings of painfulness and unpleasantness of the EEG stimuli (see “1.3.3 Relationship between Empathy, Racial Bias and Familiarity”).

### **Hypothesis for Correlation between Painfulness and Unpleasantness of EEG Stimuli and Social Desirable Responding**

The 8th hypothesis (H8) is that there is a relationship between the racial bias based on ratings of painfulness and unpleasantness of the EEG stimuli (calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*) and social desirable responding.

The hypothesis is tested as a directed (one-tailed) hypothesis because we assume that if one responds in a social desirable way, then one should show less racial bias.

## **2.5 Hypotheses for EEG Measurements**

### **Empathy for Pain - Hypothesis**

The 9<sup>th</sup> hypothesis (H9), the “Empathy for Pain - Hypothesis”, is that more alpha desynchronization is found for *pain* than for *no pain*.

Further, we hypothesize that this interaction reveals itself in somatosensory desynchronization and therefore it should be significant in central areas and maybe also in parietal, but not in frontal and occipital areas. Also, since participants watched stimuli showing right hands, this interaction should be even stronger over the left hemisphere than over the right hemisphere due to lateralized resonance.

The hypothesis is formulated as a directed hypothesis, because we assume that participants would be more empathic resonance when observing a hand being penetrated by a needle than being touched by a Q-tip - independent from whether they observe *original colored White*, *original colored Black*, *violet colored White* or *violet colored Black* stimuli. This hypothesis has been supported by numerous studies investigating empathy for pain (for example Yang et al., 2008; Perry et al., 2010; Whitmarsh et al., 2011).

### **Race - Hypothesis**

The 10<sup>th</sup> hypothesis (H10), the “Race - Hypothesis”, is that more alpha desynchronization is found for *White* than for *Black*.

Further, we hypothesize that this interaction difference varies between the areas. Also, since participants watched stimuli showing right hands, this interaction should be even stronger over the left hemisphere than over the right hemisphere due to lateralized resonance.

The hypothesis is formulated as a directed hypothesis, because we assume that due to racial group membership White participants would be more aroused when observing *White* stimuli than when observing observing *Black* stimuli - independent from whether they observe *pain* or *no pain* stimuli. This difference should be found when looking at *original colored White* and *original colored Black* stimuli. When looking at *violet colored White* and *violet colored Black* stimuli the suppression should be similar.

### **Empathy for Pain x Race - Hypothesis**

The 11<sup>th</sup> hypothesis (H11), the “Empathy for Pain x Race - Hypothesis”, is that the difference in alpha suppression of *pain* minus *no pain* is stronger for *original colored White*, *violet colored White* and *violet colored Black* than for *original colored Black*.

Further, we hypothesize that this interaction reveals itself in somatosensory resonance and therefore it should be significant in central areas and maybe also in parietal but not in frontal and occipital areas. Also, since participants watched stimuli showing right hands, this interaction should be even stronger even stronger over the left hemisphere than over the right hemisphere due to lateralized resonance.

The direction of this hypothesis is based on Avenanti et al.'s (2010) results and represents that White participants show more empathy for their racial in-group than for their racial out-group. If the factor of familiarity does not play a role for the interaction between empathy for pain and race, then White participants show similar empathy for pain for *original colored White*, *violet colored White* and *violet colored Black* but less for *original colored Black*.

## **2.6 Hypotheses for Correlations between EEG and Behavioral Measurements**

### **Hypothesis for Correlation between EEG Measurement and Evaluations assessing EEG Stimuli**

Alpha desynchronization measured with EEG was calculated by subtracting the difference of *original or violet colored Black pain* minus *original or violet colored Black no pain* from the difference of *original or violet colored White pain* minus *original or violet colored White no pain*. Since we hypothesize that this alpha suppression measured with EEG reveals itself in somatosensory alpha desynchronization, calculations were focused on data gathered from the central area on the left side.

The 12<sup>th</sup> hypothesis (H12) is that there is a relationship between the alpha desynchronization measured with EEG (calculated by subtracting the difference of *original or violet colored Black pain* minus *original or violet colored Black no pain* from the difference of *original or violet colored White pain* minus *original or violet colored White no pain*) and the score for the evaluations of the EEG stimuli (calculated by subtracting the difference of *original or violet colored Black pain* minus *original or violet colored Black no pain* from the difference of *original or violet colored White pain* minus *original or violet colored White no pain*).

The hypothesis is tested as a directed (one-tailed) hypothesis, because both EEG and behavioral measurements are assessing exactly the same stimuli. Therefore when one score increases, the other one should, too.

We assume that the measure of prosocial behavior should correlate with alpha suppression measured with EEG in a direct way:



The 13<sup>th</sup> hypothesis (H13) is that there is a relationship between alpha suppression measured with EEG (calculated by subtracting the difference of *original or violet colored Black pain* minus *original or violet colored Black no pain* from the difference of *original or violet colored White pain* minus *original or violet colored White no pain*) and prosocial behavior.

### **Hypothesis for Correlation between EEG Measurement and Explicit Empathy**

A score for the EEG measurements was calculated by subtracting *no pain* from *pain* because the paradigm empathy for pain is defined as the difference between *pain* and *no pain*.

The 14<sup>th</sup> hypothesis (H14) is that there is relationship between electrophysiological empathy for pain (calculated by subtracting *no pain* from *pain*), one's explicit empathic traits (perspective taking abilities, one's ability to identify with others, one's empathic concern and one's personal distress when observing others in need).

As empathy for pain assessed with EEG increases, explicit empathy assessed with questionnaires should, too. This is why the hypothesis is tested as a directed (one-tailed) hypothesis.

### **Hypothesis for Correlation between EEG Measurement and Implicit and Explicit Racial Bias**

For the correlation between EEG measurements and measurements of implicit and explicit racial bias, a "Electrophysiological Racial Bias" for empathy for pain was calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*. Since we hypothesize that this electrophysiological

racial bias reveals itself in the suppression of somatosensory alpha desynchronization, calculations were focused on data gathered from the central area on the left side.

The 15<sup>th</sup> hypothesis (H15) is that there is a relationship between the electrophysiological racial bias (calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*) and implicit and explicit racial bias.

We assume that higher EEG desynchronization indicated higher empathy, and therefore higher EEG desynchronization should be positively correlated with trait empathy measures

### **Hypothesis for Correlation between EEG Measurement and Explicit Familiarity**

The 16<sup>th</sup> hypothesis (H16) is that there is a relationship between electrophysiological racial bias (calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*) and explicit familiarity.

The hypothesis is tested as an undirected (two-tailed) hypothesis because familiarity with Blacks could be related to an increased or decreased electrophysiological racial bias (see “1.3.3 Relationship between Empathy, Racial Bias and Familiarity”).

### **Hypothesis for Correlation between EEG Measurement and Social Desirable Responding**

The 17<sup>th</sup> hypothesis (H17) is that there is a relationship between electrophysiological racial bias (calculated by subtracting the difference of *original colored Black pain*

minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*) and social desirable responding.

The hypothesis is tested as a directed (one-tailed) hypothesis because we assume that if one responds in a social desirable way, then one should show less racial bias.



### **3. METHODS**



## 3. METHODS

### 3.1 Participants

69 White participants (37 females) aged between 19 and 36 years ( $M = 23.16$ ,  $SD = 3.24$ ) participated in this study. Of these 69 participants 37 participants (20 females) aged between 19 and 36 years ( $M = 23.70$ ,  $SD = 3.70$ ) participated in the first session showing only *original colored White* and *original colored Black* stimuli, and the remaining 32 participants (17 females) aged between 19 and 30 years ( $M = 22.53$ ,  $SD = 2.52$ ) participated in the second session showing only *violet colored White* and *violet colored Black* stimuli. Participants received a monetary reward or a bonus for an university exam in biological psychology for their participation.

All participants were tested at the Social, Cognitive and Affective Neuroscience Unit (SCAN Unit) from the Institute of Clinical, Biological and Differential Psychology at the University of Vienna.

All participants fulfilled the inclusion criteria for this study which are: right handed according to the standard handedness inventory (Oldfield, 1971); normal or corrected vision; no neurological or psychiatric diseases; no hypersensitive scalp, eczema or birth-marks on scalp; no fractures of the scalp; no skull implants; no contagious blood-borne diseases; no diabetes or bleeding disorders; no fear of needles; no regular medication use or abuse of psychotropic drugs.

The study was conducted in accordance with the ethical standards for participants of the 1964 Declaration of Helsinki.

## 3.2 Stimuli

Experimental stimuli consisted of different types of video clips presented in a 18 x 22 cm window on a black background, presented on a 50 cm computer screen approximately 1 m away from the participants.

The video clips were created by Avenanti et al. (2010). Alessio Avenanti has given his permission that the stimuli could be used for this study. The videos showed one of the following situations: a Q-tip gently touching a *White* hand (*White no pain* condition, see Figure 6A); a needle deeply penetrating a *White* hand (*White pain* condition, see Figure 6B); a Q-tip gently touching a *Black* hand (*Black no pain* condition, see Figure 6D); a needle deeply penetrating a *Black* hand (*White pain* condition, see Figure 6E). In order to avoid an habituation effect which arises when participants watch the same clip many times, the color of the Q-tip and the shape of the syringe varied in three ways. Therefore, for each of the four conditions three types of videos were produced, resulting in twelve videos for the conditions.

All these conditions were digitally colored violet in order to create the third and fourth group of stimuli, see Figure 6C showing a digitally *violet colored White* hand or Figure 6F showing a digitally *violet colored Black* hand.

There are a few remarks one should add: First, Avenanti et al. (2010) have been aware of the fact that observing hands using tools causes an activation over the primary motor cortex (Järveläinen, Schürmann & Hari, 2004). To limit this effect, they prevented the presented hands from being moved in any way, and assured that the holder of the syringe can not be seen. Second, they used only one *White* model and one *Black* model whose hands they positioned in a similar manner.





Figure 6. Visual Stimuli for the EEG experiment. Permission for usage and slight modification by Avenanti et al. (2010).

(A) *original colored White no pain* condition.

(B) *original colored White pain* condition.

(C) Example of a *digitally violet colored White pain* condition.

(D) *original colored Black no pain* condition.

(E) *original colored Black pain* condition.

(F) Example of a *digitally violet colored White pain* condition.

From “Racial Bias Reduces Empathic Sensorimotor Resonance with Other-Race Pain”, by Avenanti et al., 2010. Reprinted with permission of the first author.

### 3.3 Procedure

The entire experiment, including all instructions, tests, and questionnaires, was conducted in German language.

First, participants read and signed an “Informed Consent to Participate in an EEG Study” (see Appendix A). Also, they completed the “Edinburgh Inventory” (Oldfield, 1971, see Appendix B) - an assessment of their handedness.

In preparation for the EEG measurement electrodes were applied and checked, during which radio music was playing. This is meant to reduce boredom and foster alertness of the participants (Luck, 2005). Participants were guided to a sound-proof and semi-darkened room where they sat down on a comfortable chair approximately 1 m away from a 50 cm computer screen (for a detailed description of this process please see “4.4.1 EEG Recording”). In order to reduce artifacts in the EEG data, participants were instructed by the experimenters to avoid looking around in the room, to focus on the screen, to avoid any major bodily movements, and to sit still, relax and only to move in one of the seven breaks. Of course, participants were also told that in the case of a cramp some movement to loosen muscles is advisable. Then, on the computer screen participants read instructions about the nature of the experiment (for the full EEG instructions see Appendix C). Importantly, these instructions did not give any information why hands were penetrated by a needle or touched by a Q-tip in the video clips. The reason for this is that Lamm et al. (2010) found that titling the hand models as patients influences the empathic response of the participants. An average of 50 minutes passed from the arrival of the participants to the beginning of the EEG recording.

During the EEG recording of the first EEG session with *White* and *Black* stimuli, one single trial started with a fixation cross being presented for one and a half seconds. A video of a static hand followed for one and a half seconds. Consecutively, a video of three seconds showed one of four situations:

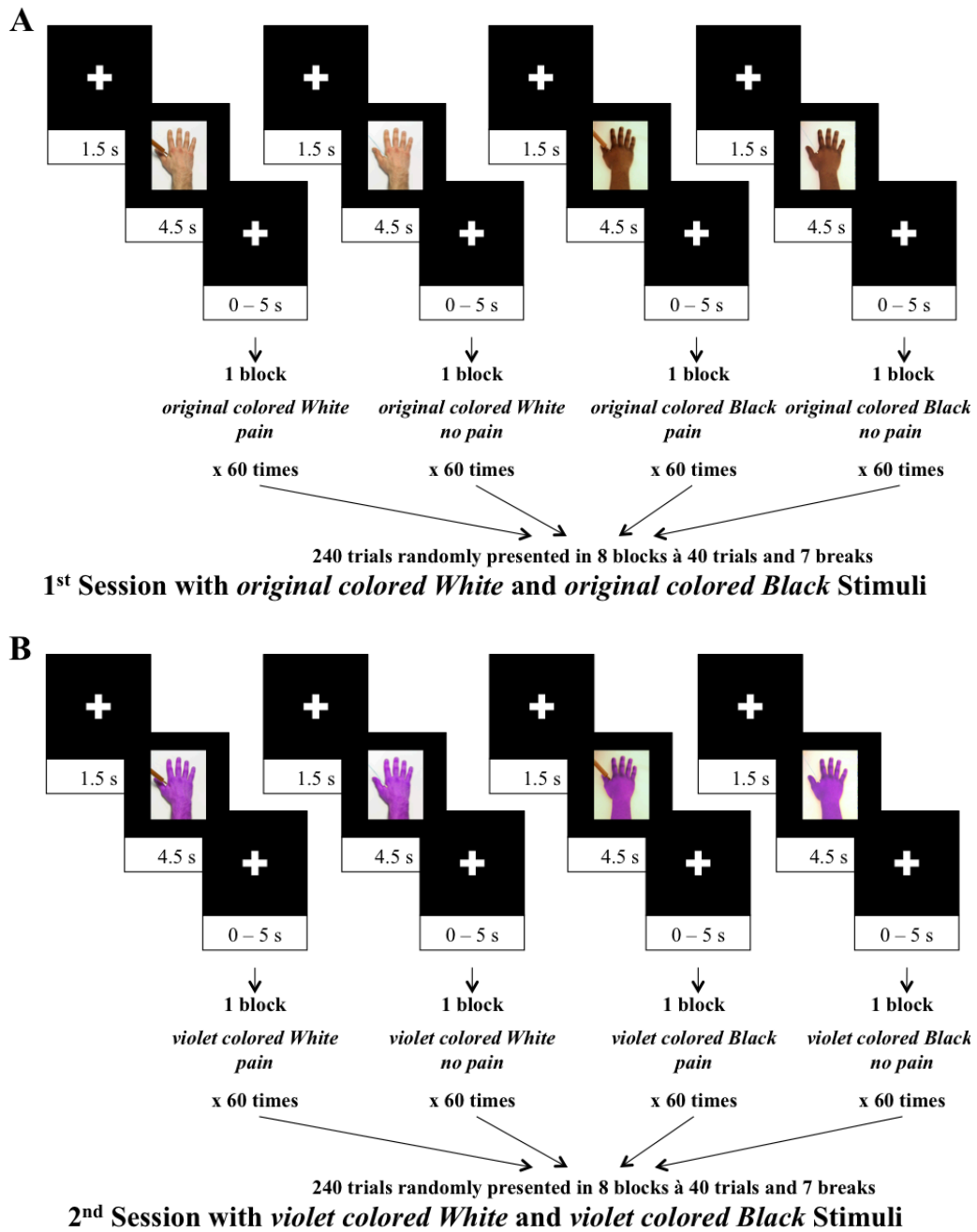


Figure 7. Schematic representation of EEG-sessions.

(A) First session with *original colored White* and *original colored Black* stimuli

(B) Second session with *violet colored White* stimuli and *violet colored Black* stimuli.

A needle penetrating a *original colored White* hand (*original colored White pain* condition) or a *original colored Black* hand (*original colored Black pain* condition),

or a Q-tip touching a *original colored White* hand (*original colored White no pain* condition) or a *original colored Black* hand (*original colored Black no pain* condition). The trial ended with a fixation cross, which was presented for a randomly varied time interval of 0-0.5 seconds allowing an intertrial interval (ITI) that reduces stimulus predictability (see Figure 7). For each of the four conditions 60 videos were presented, resulting in 240 videos being presented during the entire EEG session. These 240 trials were randomly shown in eight blocks of 40 trials each. In between these eight blocks seven breaks were given for which the participants could decide when to end them and continue. The second EEG session with *violet colored* stimuli - which included different participants than the first EEG session - had the same experimental design but the *White* and *Black* stimuli were digitally *colored violet* (Figure 7 visualizes the experimental structure of both EEG sessions). One EEG session lasted for approximately 25 minutes.

After the EEG recording ended, participants stayed at the computer to answer a few questions regarding the painfulness, unpleasantness and believability of the EEG stimuli (see Appendix D), their willingness to help the patients of the video (see Appendix E). Answering these questions took approximately 20 minutes.

After participants finished these questions, the cap with electrodes was removed and they were guided to a bathroom where they could wash their hair. This time also served as a break.

Importantly, participants completed the behavioral measurements alone in a room because many concepts which were measured could have been easily influenced by social factors, such as the presence of the White experimenters of this study. They were presented in the following order: (1) Affect Misattribution Procedure (Payne, Cheng, Govoron & Stewart, 2005); (2) Implicit Association Task (Greenwald, McGee & Schwartz, 1998, for stimuli material see Appendix G); (3) Saarbrücker Persönlichkeitsfragebogen (Paulus, 2009, see Appendix F); (4) White Preference Thermometer Difference (Project Implicit of Harvard University, 1998, see Appendix

H); (5) White Preference Likert (Project Implicit of Harvard University, 1998, see Appendix H); (6) Attitudes towards Blacks Scale (Brigham, 1993, see Appendix I); (7) Internal and External Motivation to Respond without Prejudice (Plant & Devine, 1998, see Appendix J); (8) Social Experiences Questionnaire (Brigham, 1993, see Appendix K); (9) Balanced Inventory of Desirable Responding (Musch, Brockhaus & Bröder, 2002, see Appendix L). Finally, participants provided demographic information concerning age, sex, race, political orientation, preferred party, religion, religiousness, education, major college subject, country of residence and country of birth (based on the demographic information from Project Implicit with the Implicit Association Task from Harvard University, see Appendix M). Completing all these measurements took approximately 40 minutes.

Subsequently, participants were thanked for their participation, received a piece of chocolate and informed about the research purpose of the study. Each participant was tested for maximal three hours, but most were finished after only two and a half hours.

The EEG sessions were programmed with E-Prime 2.0 (Psychology Software Tools, Inc., Sharpsburg, USA), the Implicit Association Task and the Affect Misattribution Procedure was run with Inquisit 2.0.60616 (Computer software. (2006). Seattle, WA: Millisecond Software), and all other questionnaires were presented on the online questionnaire service SoSci Survey (<https://www.soscisurvey.de>).

## **3.4 EEG Measurements**

### **3.4.1 EEG Recording**

EEG signals were recorded using 64 Ag/AgCl electrodes. An elastic electrode cap (EASYCAP GmbH; Model M10, Herrsching, Germany) assured an equidistant positioning of 59 scalp electrodes according to an expansion of the 10-20 system (Jasper, 1958). Of these 59 electrodes, an electrode lying on the mastoid behind the left and one on the mastoid behind the right ear were used as reference electrodes. Additionally, one ground electrode was applied between the eyebrows allowing an grounding of the electrode system. Lastly, in order to record the electrooculogram (EOG) four electrodes were applied in a horizontal and vertical position to the eyes - two electrodes were applied in line with the iris 1 cm above and below the left eye as well as one electrode each 1 cm next to the outer corner of the left and right eye. The EOG data could later be used offline to correct artifacts due to eye movements. After all electrodes were applied, four steps followed with the purpose to minimize skin resistance and enhance conduction between scalp and electrode: (1) hair under each electrode was moved to the side, (2) skin under each electrode was fumigated with 70 percent alcohol, (3) skin under each electrode was lightly scratched with a sterile one-use needle (Picton, Bentin, Berg, Donchin, Hillyard, Johnson, Miller, Ritter, Rchkin & Taylor, 2000), (4) each electrode was filled with electro-gel (Electro-Cap International, Inc., Eaton, OH). The impedance of each electrode was checked and the four steps were repeated until each electrode impedance was below 2 k $\Omega$ .

After these preparations, the EEG recording started in a room that was semi-darkened, sound proof and most importantly kept the EEG signal free of much electrical noise from surroundings. The EEG data was digitized at a sampling rate of 2000 Hz, meaning that 2000 samples were recorded each second.

During the entire EEG recording electrode impedance were constantly monitored. If levels had risen above acceptable levels, breaks between experiment blocks were used to repeat the moving of hair, scratching of skin and filling with electrode-gel procedures. These were repeated until the impedance levels were appropriate again.

### **3.4.2 EEG Pre-processing**

EEG data was analyzed offline with EEGLAB 6.03.b software (Delorme & Makeig, 2004) integrated in MATLAB 7.5.0 software (The MathWorks, Inc., Natick, MA).

First, means of pre-processing the data were utilized: The data was re-sampled to 256 Hz. In order to clean the data from DC offsets and slow drifts, a highpass filter of  $< 1$  Hz was used. Also, the channels were reordered and then rereferenced to the average of the two mastoids.

Second, several steps were taken to minimize data artifacts: By visual inspection parts of the channel data were rejected because they showed clear artifacts caused by uncorrectable eye or body movements, muscle activity or unstable electrode contact. Also, periods in which the subject read instructions or took a break were rejected, as they were usually represented by distorted data segments. For some datasets, parts of a few particularly distorted channels had to be interpolated using spherical spline interpolation. The cleaner the data was after these steps, the better the following Independent Component Analysis (ICA) worked. The ICA is a linear decomposition method first applied to EEG by Makeig, Bell, Jung, Sejnowski (1996). It uses various spatial filters to transform the mixed signal of the original scalp channel data into more temporally independent component signals. This allows components representing artifacts to be identified and rejected (Jung, Makeig, Humphries, Lee, McKeown, Iragui & Sejnowski, 2000). After the ICA ran through the first time, definite artifacts were rejected by another visual inspection of the channel data and a second ICA was run. After the second ICA, three sources of information were

visually inspected to identify artifact components: component time courses, component scalp maps and component spectra. For example, a typical eye artifact often shows blink amplitudes in the component time course, a highlighted activation on the frontal side of the component scalp map, and thusly do not contribute much to the frequency of interest in the component spectra. In sum, after enough components are rejected the channel data should be relatively free of artifacts. The ICA was performed for each subject separately.

Last, the dataset of each subject was epoched to include the last 500 ms of 1500 ms of the fixation cross presentation and the entire 4500 ms of the condition video presentation, and new datasets for the separate conditions were saved for the subjects individually.

### 3.4.3 EEG Analysis

Our analysis focuses on the event-related time-frequency measure “*event-related spectral perturbation*” (*ERSP*). This measure assesses event-related changes in the power spectrum, comparing the power spectrum of the baseline period to the power spectrum of the condition period, which generalizes the method of ERD and ERS (Pfurtscheller & Aranibar, 1979). Plots of the baseline-normalized ERSP visualize the power in dB at a certain frequency and certain time relative to the baseline by employing a specific color at each image pixel. In order to calculate the spectral estimate of trial  $k$  at frequency  $f$  and time  $t$  EEG lab we employed the short-time Fourier transform of EEG lab (Delorme & Makeig, 2004):

$$ERSP(f,t) = \frac{1}{n} \sum_{k=1}^n |F_k(f,t)|^2 \quad (1)$$

When computing the ERSP we used a number of 200 sliding latency windows each comparing the spectral power at frequency  $f$  and time  $t$  of the condition period to the



epoch mean power spectrum of the baseline. In other words, in order to produce the baseline-normalized ERSP the mean baseline log power spectrum is subtracted from each spectral estimate (Derlome et al., 2004). As baseline or epoch-mean power spectrum serve the 500 ms pre-stimulus which showed a fixation cross. To the baseline either the time window 1 (T1) of 2000-3000 ms (showing a needle or Q-Tip moving towards a hand) or the time window 2 (T2) of 3250-4250 ms (showing the hand being penetrated by a needle or touched by a Q-tip) was compared (see figure 7).

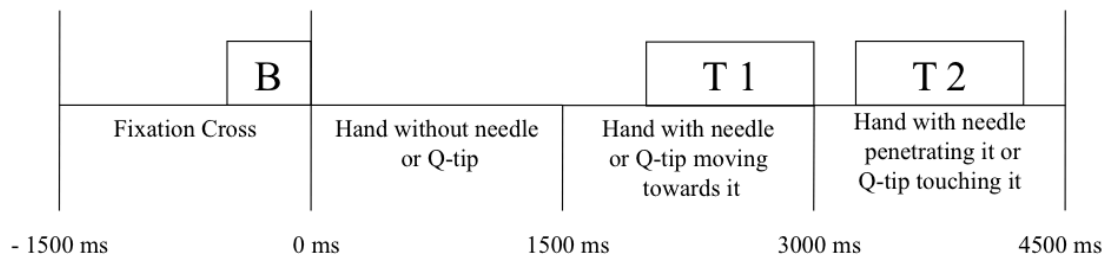


Figure 7. Presentation of one trial. As Baseline (B) the 500 ms pre-stimulus was used to which the time window 1 (T1) of 2000-3000 ms or the time window 2 (T2) of 3250-4250 ms was compared.

The ERSP was first computed for each trial, then averaged for each subject and lastly grand-averaged for all subjects. Finally for the following statistical analyses we computed the following measure:

- *ERSP for the frequency band alpha (7-14 Hz)*: The lower the ERSP for the frequency band alpha, the more alpha desynchronization.

## **3.5 Behavioral Measurements**

### **3.5.1 Measurements of Evaluations Assessing EEG Stimuli**

#### **Measurement of Painfulness, Unpleasantness and Believability (see Appendix D)**

Participants viewed all 12 types of videos for the four conditions and were asked to rate on a 7-point-Likert-scale how painful the situation was for the person (whose hand was penetrated by a needle or touched by a Q-tip), how unpleasant it was for them to watch the situation, and how believable and realistic the stimuli were.

#### **Measurement of Prosocial Behavior (see Appendix E)**

The participants read that the videos they have just seen showed patients who suffer from Hyperhidrosis Palmaris. They were then asked whether they would be willing to help prepare letters that would be sent out to gather donations.

### **3.5.2 Measurement of Explicit Empathy**

#### **Saarbrücker Persönlichkeitsfragebogen (Paulus, 2009, see Appendix F)**

Even though the Interpersonal Reactivity Index (IRI) by Davis (1980) is the most broadly used questionnaire to assess the psychological construct of empathy, Paulus (2009) points out that the original English version and translated German versions have test-theoretical shortcomings. Therefore, Paulus (2009) developed a German

version of the IRI, called “Saarbrücker Persönlichkeitsfragebogen” (SPF), which has been tested through multiple factor analyses and revised until sufficient values for reliability, validity and item selectivity had been reached. In the final version participants rate 16 items on a scale ranging from 1 (“does not apply at all”) to 5 (“applies very much”). The completion of the questionnaire takes approximately five minutes.

The SPF has the same following four factors as the IRI (Paulus, 2009):

- *Perspective Taking (PT)*: The higher the score on the perspective taking scale is, the higher is one’s ability to spontaneously take the perspective of others and to see things from their point of view - which is associated with higher social acceptance and self worth. The factor includes item 4, 10, 14 and 16.
- *Fantasy (FS)*: The higher the score on the fantasy scale is, the higher is one’s tendency to identify with characters from novels, plays, movies or other fictional works - which does not relate to social abilities or self worth but to greater physical and emotional arousal. The factor includes item 2, 7, 12 and 15.
- *Empathic Concern (EC)*: The higher the score on the empathic concern scale is, the more other-oriented feelings of concern one has when observing others in need. The factor includes item 1, 5, 9 and 11.
- *Personal Distress (PD)*: The higher the score on the personal distress scale is, the more self-oriented feelings of distress one has when observing others in need. The factor includes item 3, 6, 8 and 13.

While the perspective taking scale can be considered as a cognitive factor of empathy, the fantasy, empathic concern and personal distress scale are described as emotional factors of empathy (Davis, 1980).

Paulus (2009) highlights that the IRI and German translations of it always reached reliability values between .63 and .77, but that the SPF achieved a Cronbach-alpha reliability of .78 and a split-half-coefficient with Spearman-Brown-correction of .80.

### **3.5.3 Measurements of Implicit and Explicit Racial Bias**

We employed a selection of questionnaires and tests that assess various facets of racial bias. First, we employed the “Affect Misattribution Procedure” (Payne, Cheng, Govoron & Stewart, 2005) and the Implicit Association Task (Greenwald, Mc Gee & Schwartz, 1998) as measurements for implicit racial bias. Even though one may demonstrate no explicit racial bias when answering a questionnaire - being aware and in control of the answers one chooses to give, one might still show an implicit racial bias when completing tests such as the AMP or the IAT that measure qualities of the way one gives answers - over which one has no conscious control. The AMP differs from the IAT in that it assesses implicit racial bias without relying on direct categorization of White and Black faces, and therefore might be a potentially good new test in addition to the older and established IAT. In regard to measurements for explicit racial bias we chose from established questionnaires these ones that measure racial bias in the realms of feelings such as the “Preference Likert Scale” and the “Feeling Thermometer” ([implicit.harvard.edu](http://implicit.harvard.edu)), in the realms of attitudes such as the “Attitudes towards Blacks” questionnaire (Brigham, 1993), and in the realms of motivation such as the “Internal and External Motivation to Respond without Prejudice” (Plant & Devine, 1998).

#### **Affect Misattribution Procedure (Payne, Cheng, Govoron & Stewart, 2005)**

The AMP is based on the concept of misattribution which can be defined as “mistaking an effect of one source for the effect of another” (Payne et al., 2005). In one trial of 200 ms, participants see a picture of a White or Black face (stimulus pictures are the ones from the IAT, see Appendix H) or a neutral stimulus (a gray screen), followed by a Chinese pictograph which is also presented for 200 ms. They are instructed to simply regard the pictures of the White and Black faces as warning

signals and apart from this not to pay attention to them. Their task is to judge the visual pleasantness of the Chinese pictograph as pleasant or unpleasant. Payne et al. (2005) explain the process of misattribution by arguing that whether one judges the Chinese pictographs as pleasant or unpleasant mainly depends on if one was primed in a positive or negative way by the preceding White, Black or neutral stimuli. All together participants judge 72 Chinese pictographs. The completion of the test takes approximately five minutes.

Payne et al. (2005) exclusively analyze the proportions of the pleasant responses. They either simply compare the proportions of the pleasant responses for the White, Black and neutral stimuli or they also calculate the Cohen's effect size to also consider the standard deviation:

- *d AMP measure*: This measure subtracts the pleasant responses for White stimuli from the pleasant responses for Black stimuli and divides this difference by the standard deviation. If one gives more pleasant responses for the Chinese pictographs after seeing White stimuli than after seeing Black stimuli then one would have a negative dAMP score, which indicates an implicit White bias. Therefore, the lower a negative dAMP score, the higher the White bias.

The race AMP achieved a relatively high Cronbach-alpha reliability of .85 (Payne et al., 2005).

**Implicit Association Task (Greenwald, McGee & Schwartz, 1998, for stimulus materials see Appendix G)**

An implicit attitude is defined as “introspectively unidentified (or inaccurately identified) traces of past experience that mediate favorable or unfavorable feeling, thought, or action toward social objects” (Greenwald & Banaji, 1995, p. 8). In 1998, Greenwald et al. published the first report about the IAT which assessed implicit attitudes towards insects relative to flowers. Since then, a number of IATs assessing

attitudes towards various concepts have been developed - one such is the Race IAT which includes as target concepts pictures of White and Black faces (see Appendix H for stimulus materials) and as attribute concepts the words good and bad. In seven blocks participants have to rapidly classify words in one of the following manners: left key for White and right key for Black (block 1), left key for good and right key for Black (block 2), left key for White or good and right key for Black or bad (block 3 and 4), left key for Black and right key for White (block 5), left key for Black or good and right key for White or good (block 6 and 7). Participants complete the entire Race IAT in approximately 10 minutes.

The number of correct answers is not of primary interest, but rather the reaction times when giving correct answers. Only the fourth and seventh block are used to calculate the IAT measure. Importantly, this IAT measure can actually be calculated with a great number of different functions. However, in regard of such matters as internal consistency, magnitude of implicit-explicit correlations or the effect of prior IAT experience, the D1 measure has proved itself to have one of the most convincing characteristics (Greenwald, Nosek & Banaji, 2003) and therefore will be focused on here:

- *D1 IAT measure*: This measure divides the difference between the mean of the fourth block and the mean of the seventh block by the standard deviation of the latencies of the combined fourth and seventh block. If one shows faster responses in the fourth than in the seventh block, then one's association of White paired with good and Black paired with bad are stronger than the associations of White paired with bad and Black paired with good, which indicates an implicit White bias. A positive score indicates a White bias; the higher the score, the higher the White bias.

Interestingly, over 2.5 million IATs completed on public web sites showed the general pattern that "implicit attitudes toward culturally valued groups were shown to be positive; participants demonstrated, on average, greater positivity for White over Black, Other Peoples (non-Arab Muslims) over Arab Muslims, not -disabled versus

disabled, young over old, and straight over gay” (Lane, Banaji, Nosek & Greenwald, 2007, p. 66).

The IAT has a reasonable Cronbach-alpha reliability of .78 (Cunningham, Preacher & Banaji, 2001).

### **White Preference Thermometer Difference (Project Implicit of Harvard University, 1998, see Appendix H)**

The Project Implicit from Harvard University (<https://implicit.harvard.edu>, launched in 1998) administered an online version of the IAT to over 15,000 voluntary participants weekly. Randomly before or after the IAT a few questions are asked such as the one item assessment “Feeling Thermometer” assessing participants feelings for Whites and Blacks on a 10 point scale ranging from 1 (very warm) to 10 (very cold).

The measurement has two items each contributing to one factor:

- *Feelings for Blacks*: This one-item measure describes the how warm or cold participants feel towards Blacks. The higher the score, the colder one feels towards Blacks.
- *Feelings for Whites*: This one-item measure describes the how warm or cold participants feel towards Whites. The lower the score, the colder one feels towards Whites.

### **White Preference Likert Scale (Project Implicit of Harvard University, 1998, see Appendix H)**

Another measure we employed from the Project Implicit from Harvard University (<https://implicit.harvard.edu>, launched in 1998) is a the one item assessment “Preference Likert Scale” on a 7 point Likert scale ranging from “I strongly prefer Whites to Blacks” to “I strongly prefer Blacks to Whites”.

This item is treated as one single factor:

- *White Preference*: This one-item measure describes the sympathy or liking of Whites and Blacks usually showing a White preference for White participants (Payne, Krosnick, Pasek, Lelkes, Akhtar, & Tompson, 2009). The higher the score, the higher one prefers Whites to Blacks.

### **Attitudes towards Blacks Scale (Brigham, 1993, see Appendix I)**

Brigham (1993) agreed with the popular opinion that traditional prejudice measures are often rejected because they express discriminatory opinions too obviously, and went on to develop a questionnaire aimed at measuring discriminatory attitudes in more subtle ways. He did this by inventing items and gathering items from a number of newer questionnaires such as the Multifactor Racial Attitude Inventory (Brigham & Severy, 1976), the Symbolic Racism Scale (Kinder & Sears, 1981; Sears & Kinder, 1971), the Modern Racism Scale (McConahay, 1986; McConahay & Hough, 1976) as well as scale items by Muir (1989; Muir & Muir, 1988) and by Sidanius and Lau (1989). After several factor analyses he ended up with the “Attitudes towards Blacks Scale” (Brigham, 1993) comprising 20 items which participants rate on a scale ranging from 1 (“strongly disagree”) to 7 (“strongly agree”). The completion of the scale takes approximately five minutes.

Even though Brigham (1993) also developed an “Attitudes towards Whites Scale”, for this study only the following scale forming one single factor is of interest:

- *Attitudes towards Blacks (ATB)*: This factor describes racial attitudes towards Blacks when investigating various social issues such as urban crime, interracial marriage or racial integration in schools, businesses and residences. The factor includes items 1-20, of which the scores of the items 1, 3, 5, 6, 8, 10, 12, 15, 17 and 20 are reversed. High scores denote favorable and equalitarian views.



The Attitudes towards Blacks scale achieved a Cronbach-alpha reliability of .89 (Brigham, 1993).

### **Internal and External Motivation to Respond without Prejudice (Plant & Devine, 1998, see Appendix J)**

Plant and Devine (1998) believed that it would be worthwhile to explore whether participants purposefully conceal their prejudice and stereotype in questionnaires because of social pressure, disapproval and possible sanctions. However, they argue that when assessing the motivation to respond without prejudice, one should not only focus on external motivation, but also has to consider internal motivation. Therefore, they developed the questionnaire “Internal and External Motivation to respond without Prejudice” (Plant & Devine, 1998). Participants rate 10 items on a scale ranging from 1 (“strongly disagree”) to 9 (“strongly agree”). The completion of the questionnaire takes approximately three minutes.

The questionnaire has two scales each contributing to one factor:

- *Internal Motivation to Respond without Prejudice Scale (IMS)*: This Factor explains one’s internal motivation to respond without prejudice because of one’s personal attitudes, self-worth or beliefs. The factor includes items 6-10, of which the score of item 7 is reversed.
- *External Motivation to Respond without Prejudice Scale (EMS)*: This Factor describes one’s external motivation to respond without prejudice because of social pressure, today’s politically correct standards or disapproval and negative reactions from others. The factor includes items 1-5.

Plant and Devine (1998) point out that they opted for a short version with only 10 items because after testing three samples the Cronbach-alpha reliabilities remained between reasonable values ranging from .76 to .85.

### **3.5.5 Measurement of Familiarity**

#### **Social Experiences Questionnaire (Brigham, 1993, see Appendix K)**

Brigham (1993) developed the “Social Experiences Questionnaire” (SEQ) in order to create a measurement that assesses the amount and quality of contact with Blacks. He developed several versions with a varying amount of items; correspondence with Brigham lead to the conclusion that the 27 version would be ideal for the purpose of this study. Participants rate the 27 items on a 9 point scale ranging from 1 “friend/person” (or 0-9 % respectively) to 9 or more “friends/people” (or 90-100 % respectively) or on a 7 point scale ranging from 1 (“none”/“unpleasant”/“unprofitable”) to 7 (“many”/“pleasant”/“profitable”). The completion of the questionnaire takes approximately 10 minutes.

Several factor analyses lead to seven factors having been defined (Brigham, 1993; Slone, Brigham, & Meissner, 2000):

- *Current Contacts (CC)*: This factor is mostly based on items about the amount of people one talks to in an average week on campus, in recreational activities, in stores, in dorms and apartment complexes. The factor includes item 8, 9, 10, 11, 12, 13; all with a 9 point scale.
- *Past Contacts (PC)*: This factor mainly explains items asking about the percentage of Blacks in one’s elementary school, middle/junior school, high school and neighborhood. The factor includes item 1, 3, 5, 7, 16, 24; of which 2 items were computed to fit a 9 point scale.
- *Past Friends (PF)*: This factor describes items asking how many friends one had in elementary school, middle/junior school, high school and neighborhood. The factor includes item 2, 4, 6; all with a 9 point scale.
- *Intimacy (I)*: The intimacy factor is based on intimate question like how many of one’s closet friends are Black or if one ever was on a date with a Black

person. The factor includes item 14, 15, 20; of which 1 item was computed to fit a 9 point scale.

- *Personal Outcomes (PO)*: This factor explains items that ask about the pleasantness and perceived benefit of past and future interactions with Blacks in personal settings. The factor includes item 21, 22, 23; all with a 7 point scale.
- *Social Outcomes (SO)*: This factor describes items that ask about the pleasantness and perceived benefit of past and future interactions with Blacks in social settings. The factor includes item 25, 26, 27; all with a 7 point scale.
- *Business Outcomes (BO)*: This factor is based on items that ask about the pleasantness and perceived benefit of past and future interactions with Blacks in business settings. The factor includes item 17, 18, 19; all with a 7 point scale.

Indeed, the total SEQ score was correlated with the total ATB score with  $r(63) = .61$ ,  $p < .01$ , suggesting a cumulative effect of contact with Blacks on attitudes towards Blacks (Slone & Brigham, 2000). Hence, people who have less prejudiced attitudes towards Blacks also report higher amount and quality of contact with Blacks.

### **3.5.6 Measurement of Social Desirable Responding**

**Balanced Inventory of Desirable Responding (Paulhus, 1994, German version by Musch, Brockhaus & Bröder, 2002, see Appendix L).**

Musch et al. (2002) translated the “Balanced Inventory of Desirable Responding” (BIDR, Paulhus, 1994) from English to German and reduced the number of items from 40 to 20 based on the results of multiple factor analyses. The BIDR measures one’s tendency to lie and distort reality to create a more favorable image of oneself and others which is why the questionnaire can be used to assess participants’ general

tendency to answer truthfully. Since we employed various questionnaires assessing prejudice and stereotypes on which participants might have easily lied because of social pressure, it follows that including the BIDR would assist in reducing these confounding aspects. Participants rate the 20 items of the German BIDR on a scale ranging from 1 (“does not apply at all”) to 7 (“applies very much”). The completion of the questionnaire takes approximately five minutes.

The questionnaire has two scales each contributing to one factor:

- *Self-Deceptive Enhancement (SDE)*: This factor describes one’s subconscious tendency to answer in a manner to protect one’s self image and worth. A certain tendency to show self-deceptive enhancement is psychologically healthy and adaptive (Paulhus, 1994). The factor includes items 1-10, of which the scores of items 2, 4, 5, 7, 9 and 10 are reversed.
- *Impression Management (IM)*: This factor describes one’s conscious attempt to manipulate answers in order to present oneself in a positive way to others. The impression management scale correlates with many other questionnaires assessing lying such as personality questionnaires of Eysenck (Musch et al., 2002). The factor includes item 11-20, of which the score of item 11, 12, 14, 15, 17, 18 and 20 are reversed.

As the name of the BIDR suggest, the items of both scales are balanced, meaning that they are poled positive as well as negative, which suppresses general positive or negative answer tendencies.

Both scales have a satisfying reliability with an Alpha -cronbach of .62 for the self-deceptive enhancement scale and .65 for the impression management scale.

## **4. RESULTS**



## 4. RESULTS

### 4.1 Behavioral Results

Two mixed-design ANOVAs were performed with the between-subject factor familiarity (*original colored, violet colored*), the within-subject factor empathy for pain (*pain, no pain*), the within-subject factor race (*White, Black*) and either the dependent variable painfulness (how painful the situation was for the person whose hand was penetrated by a needle or touched by a Q-tip) or the dependent variable unpleasantness (how unpleasant it was for them to watch the situation).

#### 4.1.1 Results for Empathy for Pain of EEG Stimuli

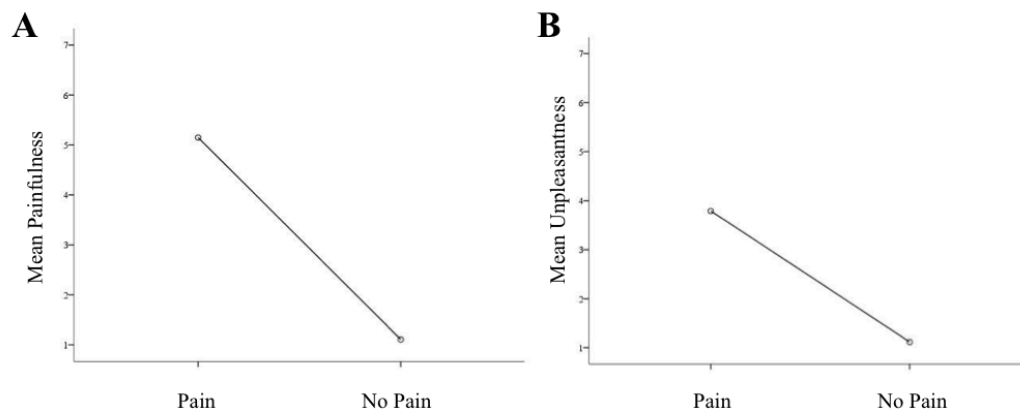


Figure 8.

(A) Means of painfulness for *pain* ( $M = 5.14$ ,  $SE = .15$ ) and *no pain* ( $M = 1.10$ ,  $SE = .03$ )

(B) Means of unpleasantness for *pain* ( $M = 3.79$ ,  $SE = .19$ ) and *no pain* ( $M = 1.11$ ,  $SE = .03$ ).

The first hypothesis (H1) is supported in that the ratings of painfulness were indeed higher for *pain* ( $M = 5.14$ ,  $SE = .15$ ) than for *no pain* ( $M = 1.10$ ,  $SE = .03$ ),  $F(1.00$ ,

67.00) = 651.46,  $MSE = 1121.084$ ,  $p < .001$ , as well as in that the ratings of unpleasantness were higher for *pain* ( $M = 3.79$ ,  $SE = .19$ ) than for *no pain* ( $M = 1.11$ ,  $SE = .03$ ),  $F(1.00, 67.00) = 214.47$ ,  $MSE = 489.818$ ,  $p < .001$  (see Figure 8).

#### **4.1.2 Results for Race of EEG Stimuli**

In regard to the second hypothesis, that the ratings of painfulness and unpleasantness are higher for *White* than for *Black*, only a tendency was found that the ratings of painfulness were higher for *White* ( $M = 3.17$ ,  $SE = .08$ ) than for *Black* ( $M = 3.07$ ,  $SE = .08$ ),  $F(1.00, 67.00) = 3.55$ ,  $MSE = 0.647$ ,  $p = .064$ .

#### **4.1.2 Results for Empathy for Pain x Race Interaction of EEG Stimuli**

The third hypothesis (H3), that the ratings of painfulness and unpleasantness are higher for *original colored White*, *violet colored White* and *violet colored Black* than for *original colored Black*, was neither supported by a significant interaction of empathy for pain x race x familiarity for painfulness ratings,  $F(1.00, 67.00) = 0.79$ ,  $MSE = 0.134$ ,  $p = .377$ , nor by a significant interaction of empathy for pain x race x familiarity for unpleasantness ratings,  $F(1.00, 67.00) = 0.72$ ,  $MSE = 0.008$ ,  $p = .790$ , (see Figure 9). Nonetheless, a priori t-Tests were planned to investigate this interaction in greater detail. Since the paradigm empathy for pain is defined by a difference between *pain* and *no pain*, we calculated the difference *pain* minus *no pain*.

Contrary to our prediction, neither for painfulness ratings was the difference of *pain* minus *no pain* higher for *original colored White* ( $M = 4.23$ ,  $SE = .19$ ) than for *original colored Black* ( $M = 4.17$ ,  $SE = .22$ ),  $t(36) = -0.40$ ,  $p = .344$  (one-tailed),  $r =$



.06, nor for unpleasantness ratings was the difference of *pain* minus *no pain* higher for *original colored White* ( $M = 3.00$ ,  $SE = .25$ ) than for *original colored Black* ( $M = 2.93$ ,  $SE = .26$ ),  $t(36) = -0.79$ ,  $p = .215$  (one-tailed), however, this did represent a small sized effect  $r = .13$ .

Also, contrary to our prediction, for painfulness ratings the difference of *pain* minus *no pain* was not similar (meaning not significantly different) for *violet colored White* ( $M = 4.00$ ,  $SE = .25$ ) and *violet colored Black* ( $M = 3.76$ ,  $SE = .26$ ),  $t(31) = -2.11$ ,  $p = .021$  (one-tailed),  $r = .36$ . However, as predicted for unpleasantness ratings the difference of *pain* minus *no pain* was similar (meaning not significantly different) for *violet colored White* ( $M = 2.42$ ,  $SE = .28$ ) and *violet colored Black* ( $M = 2.31$ ,  $SE = .25$ ),  $t(31) = -0.84$ ,  $p = .201$  (one-tailed),  $r = .15$ .

As predicted, for painfulness ratings the difference of *pain* minus *no pain* was similar (meaning not significantly different) for *original colored White* ( $M = 4.23$ ,  $SE = .19$ ) and *violet colored White* ( $M = 4.00$ ,  $SE = .25$ ),  $t(67) = .73$ ,  $p = .233$  (one-tailed),  $r = .08$ , and for unpleasantness ratings the difference of *pain* minus *no pain* was similar (meaning not significantly different) for *original colored White* ( $M = 3.00$ ,  $SE = .25$ ) and *violet colored White* ( $M = 2.42$ ,  $SE = .28$ ),  $t(67) = 1.52$ ,  $p = .066$  (one-tailed),  $r = .18$ .

Contrary to our prediction, for painfulness ratings the difference of *pain* minus *no pain* was not higher for *violet colored Black* ( $M = 3.76$ ,  $SE = .26$ ) than for *original colored Black* ( $M = 4.17$ ,  $SE = .22$ ),  $t(67) = 1.19$ ,  $p = .118$  (one-tailed), however, this did represent a small sized effect  $r = .14$ . Also, contrary to our prediction, for unpleasantness ratings the difference of *pain* minus *no pain* was actually lower for *violet colored Black* ( $M = 2.31$ ,  $SE = .14$ ) than for *original colored Black* ( $M = 2.93$ ,  $SE = .26$ ),  $t(67) = 1.71$ ,  $p = .046$  (one-tailed),  $r = .20$ .

Importantly, as predicted, regarding the effect sizes for painfulness ratings the difference of *pain* minus *no pain* comparing *original colored White* to *violet colored*

*White* did not represent a small effect, while the difference of *pain* minus *no pain* comparing *original colored Black* to *violet colored Black* did indeed represent a small effect.

In conclusion, the third hypothesis that the ratings of painfulness and unpleasantness are higher for *original colored White*, *violet colored White* and *violet colored Black* than for *original colored Black* found only limited support.

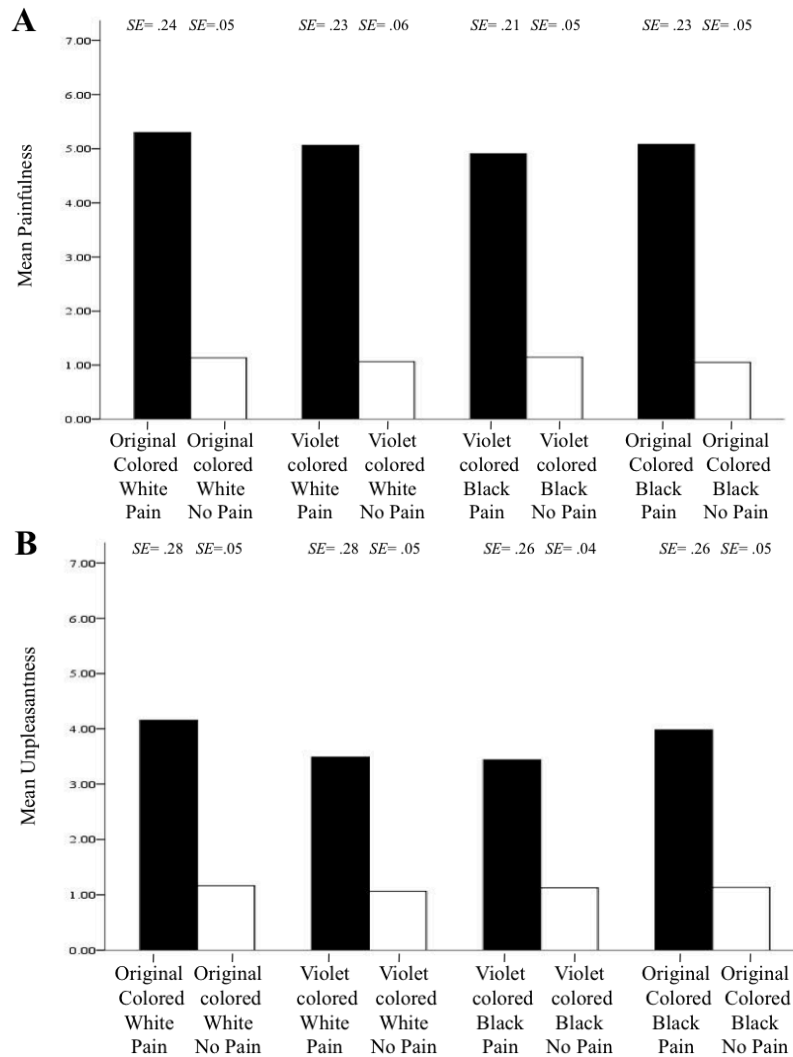


Figure 9.

(A) Mean painfulness for empathy for pain x race x familiarity

(B) Mean unpleasantness for empathy for pain x race x familiarity.

## **4.2 Results for Correlations between Painfulness and Unpleasantness of EEG Stimuli and Behavioral Measurements**

### **Results for Correlation between Painfulness and Unpleasantness of EEG Stimuli and Prosocial Behavior**

The 4th hypothesis (H4) is not supported meaning that neither the ratings of painfulness (calculated by subtracting the difference of *original or violet colored Black pain* minus *original or violet colored Black no pain* from the difference of *original or violet colored White pain* minus *original or violet colored White no pain*) correlated with prosocial behavior,  $r_s = .02, p = .429$  (one-tailed), nor were the ratings of unpleasantness (calculated by subtracting the difference of *original or violet colored Black pain* minus *original or violet colored Black no pain* from the difference of *original or violet colored White pain* minus *original or violet colored White no pain*) correlated with prosocial behavior,  $r_s = .02, p = .420$  (one-tailed).

### **Results for Correlation between Painfulness and Unpleasantness of EEG Stimuli and Explicit Empathy**

Indeed, the 5th hypothesis (H5) was supported in that the higher one's empathy for pain based on the ratings of painfulness (calculated by subtracting *no pain* from *pain*), the higher was one's ability to identify with others,  $r_s = .20, p = .046$  (one-tailed). Also, the higher one's empathy for pain based on the ratings of unpleasantness (calculated by subtracting *no pain* from *pain*), the higher was one's empathic concern,  $r_s = .20, p = .046$  (one-tailed), as well as the higher was one's personal distress  $r = .23, p = .028$  (one-tailed).

There was no significant relationship between one's empathy for pain based on the ratings of painfulness (calculated by subtracting *no pain* from *pain*) and one's perspective taking abilities,  $r_s = -.00$ ,  $p = .494$  (one-tailed), one's empathic concern  $r_s = .08$ ,  $p = .253$  (one-tailed), or one's personal distress,  $r = .01$ ,  $p = .467$  (one-tailed). Also, no significant relationship was found between the amount of one's empathy for pain based on the ratings of unpleasantness (calculated by subtracting *no pain* from *pain*) and one's perspective taking abilities  $r_s = -.06$ ,  $p = .286$  (one-tailed), or one's ability to identify with others,  $r_s = .10$ ,  $p = .192$  (one-tailed).

### **Results for Correlation between Painfulness and Unpleasantness of EEG Stimuli and Implicit and Explicit Racial Bias**

The 6th hypothesis (H6) was supported in that the higher the racial bias based on ratings of unpleasantness of the EEG stimuli (calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*), the less White preference,  $r_s = -.32$ ,  $p = .026$  (one-tailed), and colder feelings for Blacks,  $r_s = -.29$ ,  $p = .040$  (one-tailed). Also, there was a tendency for significance for higher racial bias based on ratings of painfulness of the EEG stimuli (calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*), colder feelings for Blacks,  $r_s = -.24$ ,  $p = .068$  (one-tailed), more negative attitudes towards Blacks,  $r_s = -.24$ ,  $p = .072$  (one-tailed), and less internal motivation to respond without prejudice,  $r_s = -.23$ ,  $p = .081$  (one-tailed).

No significant relationships were found between the racial bias based on ratings of painfulness of the EEG stimuli (calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*) and implicit racial bias measured with the IAT,  $r_s = -.06$ ,  $p = .359$  (one-tailed), implicit racial bias

measured with the AMP,  $r_s = -.03$ ,  $p = .415$  (one-tailed), White preference,  $r_s = -.05$ ,  $p = .366$  (one-tailed), feelings for Whites,  $r_s = -.16$ ,  $p = .172$  (one-tailed), feelings for White minus feelings for Blacks,  $r_s = .05$ ,  $p = .367$  (one-tailed), or external motivation to respond without prejudice,  $r_s = .07$ ,  $p = .331$  (one-tailed). Also, no significant relationships were found between the racial bias based on ratings of unpleasantness of the EEG stimuli (calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*) and implicit racial bias measured with the IAT,  $r_s = .07$ ,  $p = .355$  (one-tailed), implicit racial bias measured with the AMP,  $r_s = .14$ ,  $p = .199$  (one-tailed), feelings for Whites,  $r_s = -.20$ ,  $p = .422$  (one-tailed), feelings for White minus feelings for Blacks,  $r_s = .03$ ,  $p = .181$  (one-tailed), attitudes towards Blacks,  $r_s = .13$ ,  $p = .218$  (one-tailed), internal motivation to respond without prejudice,  $r_s = .20$ ,  $p = .107$  (one-tailed), or external motivation to respond without prejudice,  $r_s = .08$ ,  $p = .317$  (one-tailed).

### **Results for Correlation between Painfulness and Unpleasantness of EEG Stimuli and Familiarity**

The 7th hypothesis (H7) is supported in that there is a tendency for a significant relationship between current contacts with Blacks and painfulness of the EEG stimuli (calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*),  $r_s = -.30$ ,  $p = .064$  (one-tailed), as well as unpleasantness of the EEG stimuli (calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*),  $r_s = -.31$ ,  $p = .055$  (one-tailed).

However, no significant relationship was found between painfulness of the EEG stimuli (calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain*

minus *original colored White no pain*) and past contacts,  $r_s = .06$ ,  $p = .690$ , past friends,  $r_s = -.11$ ,  $p = .511$ , intimacy,  $r_s = -.03$ ,  $p = .857$ , personal outcomes,  $r_s = .04$ ,  $p = .407$ , social outcomes,  $r_s = -.11$ ,  $p = .517$  and business outcomes,  $r_s = .03$ ,  $p = .833$ . Also, no significant relationship was found between unpleasantness of the EEG stimuli (calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*) and past contacts,  $r_s = .26$ ,  $p = .108$ , past friends,  $r_s = .08$ ,  $p = .607$ , intimacy,  $r_s = -.16$ ,  $p = .327$ , personal outcomes,  $r_s = -.05$ ,  $p = .758$ , social outcomes,  $r_s < -.00$ ,  $p = .958$  and business outcomes,  $r_s = .02$ ,  $p = .867$ .

### **Results for Correlation between Painfulness and Unpleasantness of EEG Stimuli and Social Desirable Responding**

The 8th hypothesis (H8) was not supported meaning no significant relationship was found between the racial bias based on ratings of painfulness of the EEG stimuli (calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*) and self-deceptive enhancement,  $r_s = .07$ ,  $p = .334$  (one-tailed) or impression management,  $r_s = .03$ ,  $p = .422$  (one-tailed). Similarly, no significant relationship was found between the racial bias based on ratings of unpleasantness of the EEG stimuli (calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*) and self-deceptive enhancement,  $r_s = .04$ ,  $p = .390$  (one-tailed) or impression management,  $r_s = -.04$ ,  $p = .400$  (one-tailed).

### 4.3 EEG Results

A mixed-design ANOVA was performed with the between-subject factor familiarity (*original colored, violet colored*), the within-subject factor empathy for pain (*pain, no pain*), the within-subject factor race (*White, Black*), the within-subject factor area (*frontal, central, parietal, occipital*) and the within-subject factor side (*left, middle, right*).

This five-factorial ANOVA was performed two times:

1. First, using as dependent variable the alpha ERSP which was calculated by comparing the baseline of 500 ms pre-stimulus to the time window 1 (T1) of 2000-3000 ms (showing a needle or Q-Tip moving towards a hand).
2. Second, using as dependent variable the alpha ERSP which was calculated by comparing the baseline of 500 ms pre-stimulus to the time window 2 (T2) of 3250-4250 ms (showing the hand being penetrated by a needle or touched by a Q-tip).

Table 3 and 4 report the full results of these ANOVAs, followed by a selective discussion of the results that were most relevant for our hypotheses. All effects are reported as significant at  $p \leq .05$ .

Table 3

*Analysis of Variance employing as Dependent Variable the ERSP for the Frequency Band Alpha (7 – 14 Hz) which was calculated by comparing the baseline of 500 ms pre-stimulus to the time window 1 (T1) of 2000-3000 ms post-stimulus*

Source	<i>df</i>	<i>F</i>	$\eta$	<i>p</i>
Between subjects				
Familiarity (F)	1	0.24	.00	.625
F within-group error	67	(4.73)		
Within subjects				
Pain (P)	1.00	0.71	.01	.402
Race (R)	1.00	1.85	.02	.178
Area (A)	2.23	51.39**	.43	.000
Side (S)	1.86	20.17**	.23	.000
P × F	1.00	6.95**	.09	.010
P × A	1.62	1.3	.02	.260
P × A × F	1.62	1.41	.02	.248
P × S	1.59	5.74**	.07	.008
P × S × F	1.59	0.90	.01	.387
P × A × S	3.24	1.17	.01	.323
P × A × S × F	3.24	0.99	.01	.400
R × F	1.00	0.34	.00	.561
R × A	2.03	2.26	.03	.107
R × A × F	2.03	5.27**	.07	.006
R × S	1.43	1.14	.01	.307
R × S × F	1.43	0.74	.01	.435
R × A × S	3.81	1.04	.01	.382
R × A × S × F	3.81	1.09	.01	.358
P × R	1.00	3.06	.04	.085
P × R × F	1.00	0.77	.01	.381
P × R × A	1.98	1.09	.01	.336
P × R × A × F	1.98	0.40	.00	.668
P × R × S	1.63	0.55	.00	.542
P × R × S × F	1.63	1.05	.01	.339
P × R × A × S	3.20	0.61	.09	.615
P × R × A × S × F	3.20	0.26	.00	.861
A × F	2.23	0.12	.00	.905
S × F	1.86	1.52	.02	.221
A × S	4.65	11.22**	.14	.000
A × S × F	4.65	1.10	.01	.356
P × R within group error	67	(5.96)		

Note. Values enclosed in parentheses represent mean square errors. *F* = Greenhouse-Geisser corrected *F* values; *df* = Greenhouse-Geisser corrected degrees of freedom.

\* *p* < .05. \*\* *p* < .01.



Table 4

*Analysis of Variance employing as Dependent Variable the ERSP for the Frequency Band Alpha (7 – 14 Hz) which was calculated by comparing the baseline of 500 ms pre-stimulus to the time window 2 (T2) of 3250-4250 ms post-stimulus*

Source	<i>df</i>	<i>F</i>	$\eta$	<i>p</i>
Between subjects				
Familiarity (F)	1	0.06	.00	.808
F within-group error	67	(2.84)		
Within subjects				
Pain (P)	1.00	13.89**	.01	.000
Race (R)	1.00	0.84	.01	.360
Area (A)	2.18	44.14**	.39	.000
Side (S)	1.93	20.14**	.23	.000
P × F	1.00	1.73	.02	.193
P × A	2.03	2.91*	.04	.057
P × A × F	2.03	1.31	.01	.272
P × S	1.85	1.31	.01	.271
P × S × F	1.85	1.43	.02	.243
P × A × S	3.25	0.97	.01	.442
P × A × S × F	3.25	0.92	.01	.434
R × F	1.00	2.55	.03	.115
R × A	1.97	2.65	.03	.075
R × A × F	1.97	4.89**	.06	.009
R × S	1.61	0.05	.00	.921
R × S × F	1.61	0.31	.00	.681
R × A × S	4.24	1.35	.02	.246
R × A × S × F	4.24	1.08	.01	.370
P × R	1.00	2.92	.04	.092
P × R × F	1.00	0.01	.00	.907
P × R × A	2.04	3.92*	.05	.021
P × R × A × F	2.04	0.98	.01	.383
P × R × S	1.50	1.19	.01	.297
P × R × S × F	1.50	0.21	.00	.804
P × R × A × S	3.23	0.21	.00	.901
P × R × A × S × F	3.23	1.85	.02	.134
A × F	2.18	1.09	.01	.352
S × F	1.93	0.76	.01	.468
A × S	4.57	11.52**	.14	.000
A × S × F	4.57	0.96	.01	.435
P × R within group error	67	(5.77)		

Note. Values enclosed in parentheses represent mean square errors. *F* = Greenhouse-Geisser corrected *F* ratios; *df* = Greenhouse-Geisser corrected degrees of freedom.

\*  $p \leq .05$ . \*\*  $p \leq .01$ .

### 4.3.1 Results for Empathy for Pain - Hypothesis

The 9<sup>th</sup> hypothesis (H9), the “Empathy for Pain - Hypothesis”, is supported for time 2, meaning that indeed participants showed more alpha desynchronization for *pain* ( $M = -2.37, SE = .21$ ) than for *no pain* ( $M = -2.02, SE = .20$ ),  $F(1.00, 67.00) = 13.89$ ,  $MSE = 97.291, p < .001$  (see Figure 10).

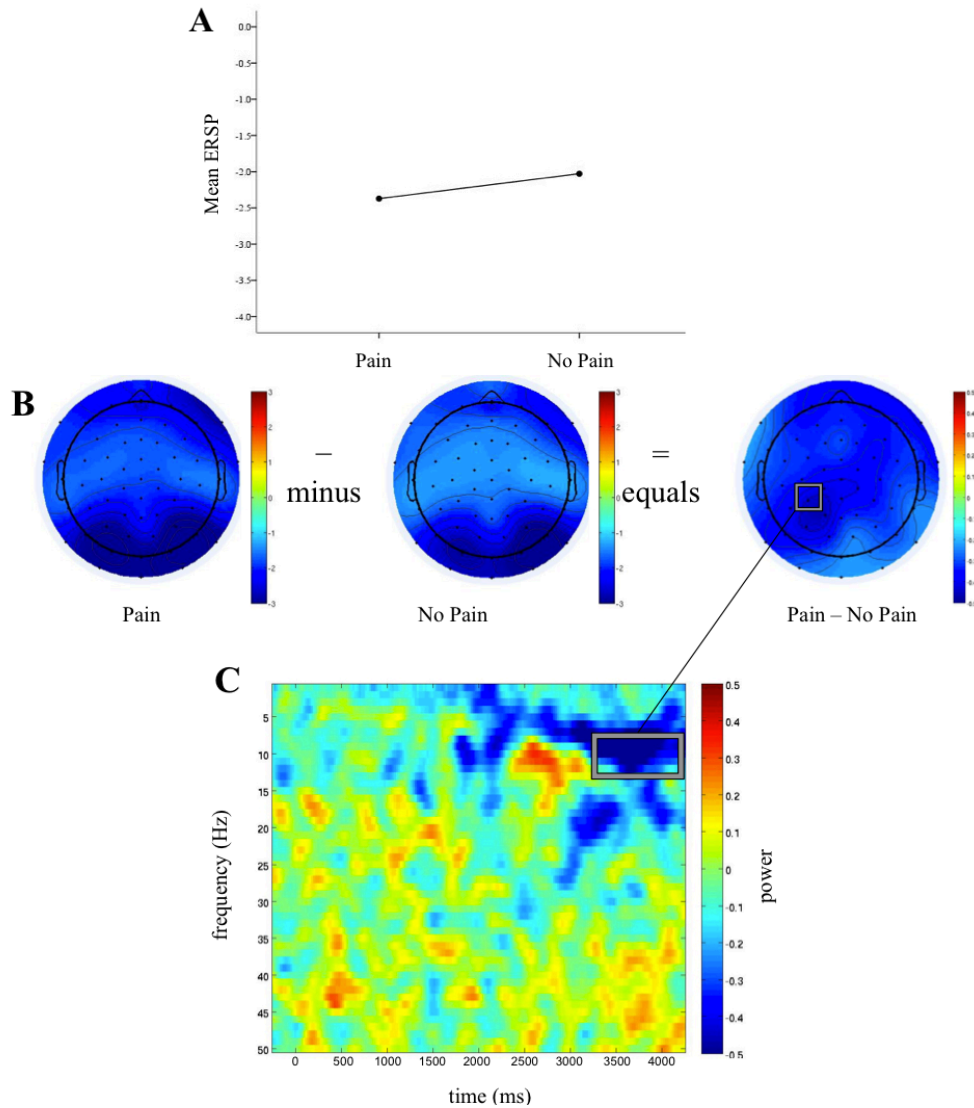


Figure 10.

(A) Mean ERSP for *pain* ( $M = -2.37, SE = .21$ ) and for *no pain* ( $M = -2.02, SE = .20$ )

(B) Topographic plots for alpha (7-14 Hz) for time 2 (3250ms - 4250 ms)

(C) Time-frequency plot for electrode 45 in the *central* area on the *left* side.

Also, for time 2 a trend towards for a significant interaction was found for empathy for pain and area,  $F(2.03, 136.01) = 2.91$ ,  $MSE = 1.692$ ,  $p = .057$  (see Figure 11). As one can see, when looking at absolute values of alpha suppression, the most suppression seems to appear in the *occipital* area for *pain* ( $M = 3.18$ ,  $SE = .27$ ) and *no pain* ( $M = -2.93$ ,  $SE = .26$ ), medium suppression in the *parietal* area for *pain* ( $M = -2.56$ ,  $SE = .24$ ) and *no pain* ( $M = -2.17$ ,  $SE = .22$ ), and the lowest in the *central* for *pain* ( $M = -1.90$ ,  $SE = .20$ ) and *no pain* ( $M = -1.49$ ,  $SE = .18$ ) as well as the *frontal* for *pain* ( $M = -1.83$ ,  $SE = .21$ ) and *no pain* ( $M = -1.50$ ,  $SE = .20$ ). Since the very strong alpha suppression for the *occipital* area was most likely related to visual stimulation, we conducted another ANOVA (for complete ANOVA Table see Appendix N) in which we used as a dependent variable the alpha ERSP which was calculated by comparing the time window 2 (T2) of 3250-4250 ms to the baseline of 1000-1500 ms post-stimulus (showing a hand without needle or Q-tip) instead of comparing the time window 2 to the baseline of 500 ms pre-stimulus (showing a fixation cross). The logic behind this is that the very high alpha suppression for the *occipital* area may be the consequence of visual processing which is very pronounced when comparing a visually simplistic fixation cross to a visually complex video in which a needle is penetrating a hand or a Q-tip is touching the hand. Comparatively, this should be less pronounced when comparing a visually complex video of a hand without needle or Q-tip to a similarly visually complex video in which a needle is penetrating a hand or a Q-tip is touching the hand. In the ANOVA with the hand as baseline, a significant interaction was found for empathy for pain and area,  $F(2.29, 153.80) = 5.11$ ,  $MSE = 1.377$ ,  $p = .005$ . Now, different from when we conducted the ANOVA with the fixation cross as baseline, when looking at the absolute values of alpha suppression for the ANOVA with the hand as baseline, less absolute difference was found between the *occipital* area for *pain* ( $M = -0.24$ ,  $SE = .08$ ) and *no pain* ( $M = -0.36$ ,  $SE = .08$ ), the *parietal* area for *pain* ( $M = -0.21$ ,  $SE = .10$ ) and *no pain* ( $M = -0.46$ ,  $SE = .10$ ), the *central* area for *pain* ( $M = -0.05$ ,  $SE = .08$ ) and *no pain* ( $M = -0.23$ ,  $SE = .08$ ) and the *frontal* area for *pain* ( $M = -0.18$ ,  $SE = .07$ ) and *no pain* ( $M = -0.06$ ,  $SE = .07$ ). Hence, the very alpha desynchronization in *occipital* areas does indeed arise from visual processing. Nonetheless, we opted to continue to test our hypotheses with

ANOVAs using the fixation cross as baseline, as all other similar studies have used a fixation cross as baseline, and we wanted our results to be comparable to them. Finally, since the paradigm empathy for pain is defined by a difference between *pain* and *no pain*, planned t-Tests were conducted to assess whether this difference was significant at all areas, which was the case: In the *frontal* area, *pain* ( $M = -1.82$ ,  $SE = 1.73$ ) was more suppressed than *no pain* ( $M = -1.50$ ,  $SE = 1.68$ ),  $t(68) = -4.22$ ,  $p < .001$ ,  $r = .45$ . In the *central* area, *pain* ( $M = -1.89$ ,  $SE = .20$ ) was more suppressed than *no pain* ( $M = -1.49$ ,  $SE = .17$ ),  $t(68) = 4.00$ ,  $p < .001$ ,  $r = .45$ . In the *parietal* area, *pain* ( $M = -2.55$ ,  $SE = .23$ ) was more suppressed than *no pain* ( $M = -1.82$ ,  $SE = .19$ ),  $t(68) = -6.23$ ,  $p < .001$ ,  $r = .63$ . In the *occipital* area, *pain* ( $M = -3.17$ ,  $SE = 0.26$ ) was more suppressed than *no pain* ( $M = -2.93$ ,  $SE = 0.25$ ),  $t(68) = 2.11$ ,  $p = .019$  (one-tailed),  $r = .25$ . Hence, even though this difference in total was very suppressed in the *occipital* area, what is important is that we still found that *pain* is more suppressed than *no pain* (and not *no pain* more than *pain*) for all areas. Interestingly, regarding the effect sizes, the difference of *pain* minus *no pain* represented a medium-sized effect in the *frontal* and *central* area, a large-sized effect in the *parietal* area, but only a small-sized effect in the *occipital* area.

Furthermore, for time 1 a significant interaction was revealed for empathy for pain and side,  $F(1.59, 106.66) = 5.74$ ,  $MSE = 0.982$ ,  $p = .008$ . However, our hypothesis that more alpha suppression is found on the *left* side than the *right* side was not supported, in fact the opposite seemed to be case, meaning that for *pain* more alpha desynchronization was found than on the *right* side ( $M = -2.90$ ,  $SE = .29$ ) than on the *left* side ( $M = -2.65$ ,  $SE = .28$ ) as well as *no pain* was more suppressed on the *right* side ( $M = -2.78$ ,  $SE = .26$ ) than on the *left* side ( $M = -2.60$ ,  $SE = .26$ ). However, this does not reveal much, because the paradigm empathy for pain is defined by a difference between *pain* and *no pain*. We therefore conducted planned t-Tests in order to assess whether the difference of *pain* minus *no pain* was significant at both sides, which was the case: On the *left* side, more alpha desynchronization was found for *pain* ( $M = -2.62$ ,  $SE = .28$ ) than for *no pain* ( $M = -2.60$ ,  $SE = .26$ ),  $t(68) = -3.86$ ,  $p < .001$ ,  $r = .45$ . Also, on the *right* side, more alpha desynchronization was found for

*pain* ( $M = -2.90, SE = .29$ ) than for *no pain* ( $M = -2.78, SE = .26$ ),  $t(68) = -3.45, p = .001, r = .38$ . Hence, even though this difference in total was more suppressed on the *right* than the *left* side, what is important is that we still found that *pain* is more suppressed than *no pain* (and not *no pain* more than *pain*) on both sides.

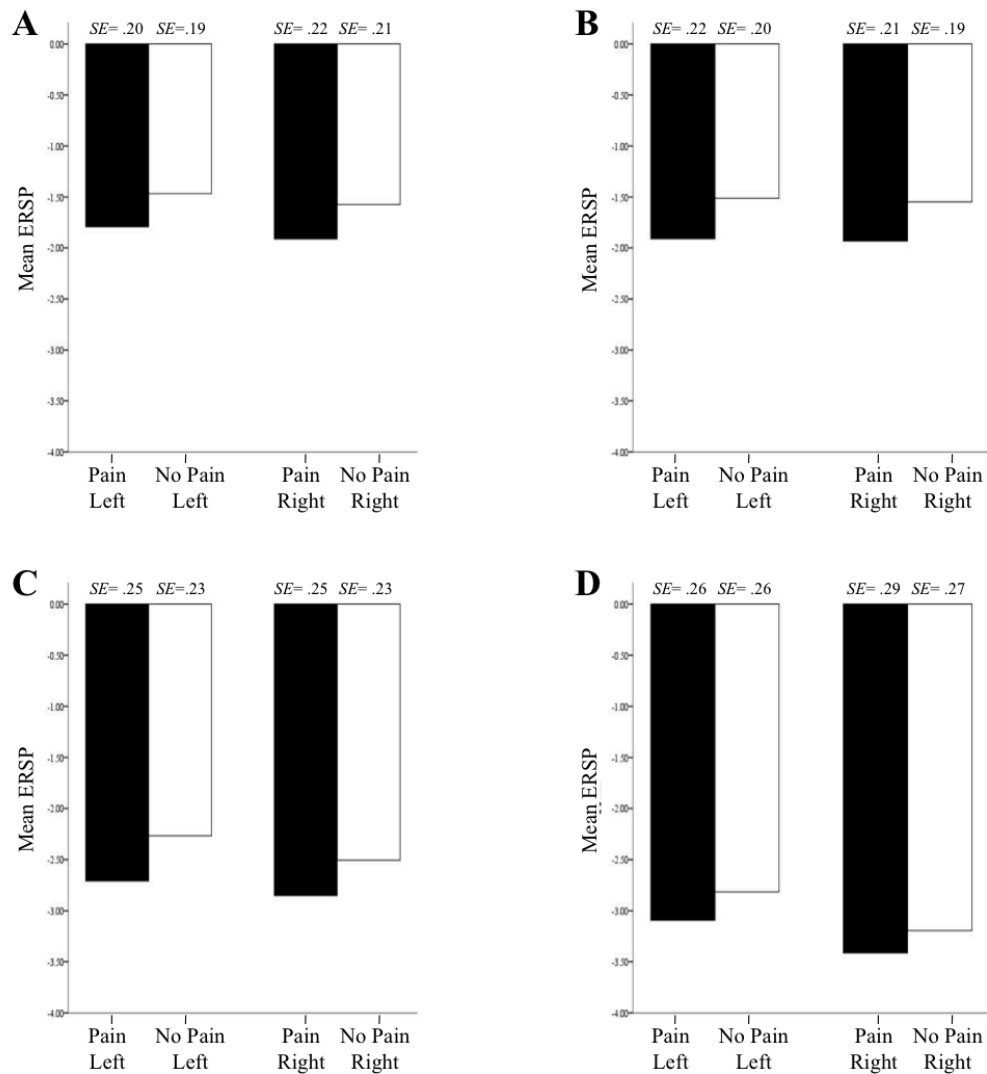


Figure 11. Mean ERSP for empathy for pain for time 2.

- (A) Mean ERSP for *pain* and *no pain* in the *frontal* area on the *left* and *right* side
- (B) Mean ERSP for *pain* and *no pain* in the *central* area on the *left* and *right* side
- (C) Mean ERSP for *pain* and *no pain* in the *parietal* area on the *left* and *right* side
- (D) Mean ERSP for *pain* and *no pain* in the *occipital* area on the *left* and *right* side.

### 4.3.2 Results for Race - Hypothesis

In regards to the 10<sup>th</sup> hypothesis (H10), the “Race - Hypothesis”, which states that more alpha desynchronization is found for *White* than for *Black*, a significant race x area x familiarity interaction was found for time 1,  $F(2.03, 136.23) = 5.27$ ,  $MSE = 5.852$ ,  $p = .006$ , as well as for time 2,  $F(1.97, 132.38) = 4.89$ ,  $MSE = 5.432$ ,  $p = .009$ , (see Figure 12). However, this does not support our “Race - Hypothesis”, because neither for time 1 more alpha desynchronization was found for *original colored White* in the *frontal* ( $M = -1.66$ ,  $SE = .333$ ), *central* ( $M = -2.04$ ,  $SE = .344$ ), *parietal* ( $M = -2.89$ ,  $SE = .422$ ) and *occipital* area ( $M = -3.45$ ,  $SE = .432$ ) than for *original colored Black* in the *frontal* ( $M = -1.58$ ,  $SE = .347$ ), *central* ( $M = -1.87$ ,  $SE = .359$ ), *parietal* ( $M = -2.79$ ,  $SE = .422$ ) and *occipital* area ( $M = -3.56$ ,  $SE = .443$ ) nor for time 2 more alpha desynchronization was found for *original colored White* in the *frontal* ( $M = -1.60$ ,  $SE = .286$ ), *central* ( $M = -1.68$ ,  $SE = .261$ ), *parietal* ( $M = -2.31$ ,  $SE = .326$ ) and *occipital* area ( $M = -2.89$ ,  $SE = .373$ ) than for *original colored Black* in the *frontal* ( $M = -1.62$ ,  $SE = 2.82$ ), *central* ( $M = -1.60$ ,  $SE = .260$ ), *parietal* ( $M = -2.33$ ,  $SE = .303$ ) and *occipital* area ( $M = -3.15$ ,  $SE = .352$ ), (see Figure 10).

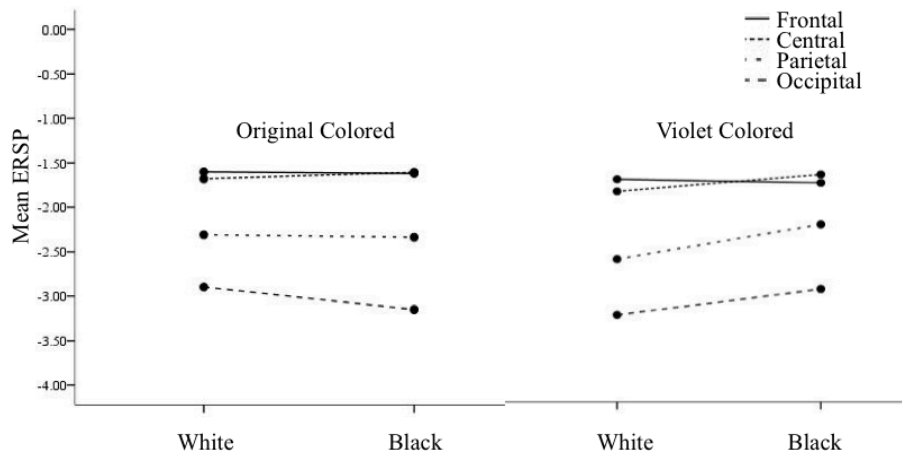


Figure 12. Race x familiarity x area interaction for time 2.

### 4.3.3 Results for Empathy for Pain x Race Interaction - Hypothesis

The main hypothesis that this thesis strives to address is the 11<sup>th</sup> hypothesis, the “Empathy for Pain x Race - Hypothesis”, which says that the difference in alpha suppression of *pain* minus *no pain* is more suppressed for *original colored White*, *violet colored White* and *violet colored Black* than for *original colored Black*. Further, we hypothesize that this interaction reveals itself in somatosensory desynchronization, and therefore should be significant in central areas and perhaps also in parietal, but not in frontal and occipital areas. Also, since participants watched stimuli showing right hands, this interaction should be even stronger over the *left* hemisphere than over the *right* hemisphere due to lateralized resonance.

The most specific assessment of our hypothesis is achieved, when one looks at whether the empathy for pain, race and familiarity interaction is displayed in each individual area and for each individual side. Hence, one needs to look at the five-way interaction of empathy for pain, race, familiarity, area and side.

For time 2 no significant interaction of empathy for pain, race, familiarity, area and side can be reported,  $F(3.23, 216.57) = 1.85$ ,  $MSE = 0.180$ ,  $p = .134$ . Also ANOVAs which were conducted separately for all four areas did not reveal a significant pain x race x familiarity interaction in the *frontal* area,  $F(1.00, 67.00) = 0.05$ ,  $MSE = 0.018$ ,  $p = .824$ , in the *central* area,  $F(1.00, 67.00) = 0.06$ ,  $MSE = 0.034$ ,  $p = .803$ , in the *parietal* area,  $F(1.00, 67.00) = 0.20$ ,  $MSE = 0.158$ ,  $p = .655$  or in the *occipital* area,  $F(1.00, 67.00) = 0.49$ ,  $MSE = 0.342$ ,  $p = .483$ . Nonetheless, a priori it was planned to investigate the pain x race x familiarity interaction in the greatest detail with a number of dependent and independent t-Tests, (see Figure 13 A - B which show the empathy for pain, race and familiarity interaction for the *central* area on the *left* side). Since the paradigm empathy for pain is defined by a difference between *pain* and *no pain*, we calculated the difference of *pain* minus *no pain*.

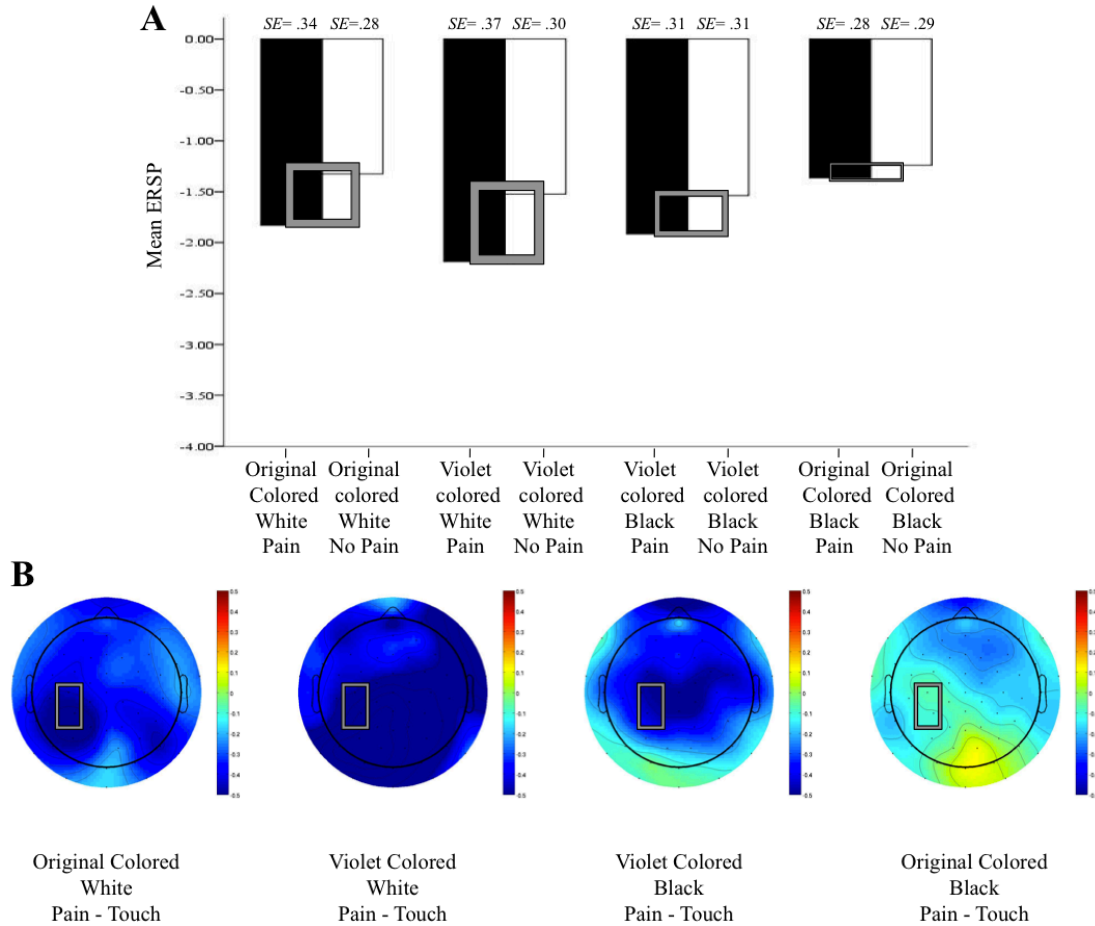


Figure 13.

(A) Empathy for pain x race x familiarity for the *central* area and *left* side for time 2  
 (B) Topographic plots for alpha (7-14 Hz) for time 2 (3250ms - 4250 ms).

First, the assumption of the “Empathy for Pain x Race - Hypothesis” was assessed stating that the difference in alpha suppression of *pain* minus *no pain* is more suppressed for *original colored White*, *violet colored White* and *violet colored Black* than for *original colored Black*, and that this interaction reveals itself in somatosensory desynchronization and therefore should be significant in the *central* area and possibly in the *parietal* area, but not in *frontal* and *occipital* areas.

As predicted, in the *central* area the difference in alpha suppression of *pain* minus *no pain* was significantly more suppressed for *original colored White* ( $M = -0.41$ ,  $SE = .15$ ) than for *original colored Black* ( $M = -0.12$ ,  $SE = .63$ ),  $t(36) = 1.70$ ,  $p = .048$



(one-tailed), which almost represents a medium-sized effect  $r = .27$ . Also, in the *parietal* area the difference in alpha suppression of *pain* minus *no pain* was significantly more suppressed for *original colored White* ( $M = -0.42$ ,  $SE = .16$ ) than for *original colored Black* ( $M = -0.03$ ,  $SE = .12$ ),  $t(36) = 1.92$ ,  $p = .031$  (one-tailed), which also almost represents a medium-sized effect  $r = .27$ . As hypothesized, in the *frontal* area the difference of *pain* minus *no pain* was not significantly more suppressed for *original colored White* ( $M = -0.32$ ,  $SE = .13$ ) than for *original colored Black* ( $M = -0.22$ ,  $SE = .09$ ),  $t(36) = 0.61$ ,  $p = .270$  (one-tailed),  $r = .10$ . However, in the *occipital* area the difference of *pain* minus *no pain* was more suppressed for *original colored White* ( $M = -0.26$ ,  $SE = .74$ ) than for *original colored Black* ( $M = -0.03$ ,  $SE = .69$ ),  $t(36) = 2.15$ ,  $p = .019$  (one-tailed), but this result may have only become significant due to visual processing and only represents a small-sized effect  $r = .10$ .

Also, as predicted, in the *central* area the difference in alpha suppression of *pain* minus *no pain* was similarly (meaning not significantly different) suppressed for *violet colored White* ( $M = -0.64$ ,  $SE = .32$ ) and for *violet colored Black* ( $M = -0.45$ ,  $SE = .10$ ),  $t(31) = 0.595$ ,  $p = .278$  (one-tailed),  $r = .10$ , in the *parietal* area the difference in alpha suppression of *pain* minus *no pain* was similarly suppressed for *violet colored White* ( $M = -0.76$ ,  $SE = .35$ ) and for *violet colored Black* ( $M = -0.96$ ,  $SE = .15$ ),  $t(31) = -0.53$ ,  $p = .299$  (one-tailed),  $r = .09$ , in the *frontal* area the difference in alpha suppression of *pain* minus *no pain* was similarly suppressed for *violet colored White* ( $M = -0.39$ ,  $SE = .23$ ) and for *violet colored Black* ( $M = -0.35$ ,  $SE = .10$ ),  $t(31) = 0.14$ ,  $p = .443$  (one-tailed),  $r = .02$ , as well as in the *occipital* area the difference in alpha suppression of *pain* minus *no pain* was similarly suppressed for *violet colored White* ( $M = -0.66$ ,  $SE = 2.20$ ) and for *violet colored Black* ( $M = -0.08$ ,  $SE = .76$ ),  $t(31) = 1.45$ ,  $p = .077$  (one-tailed),  $r = .03$ .

Further, as predicted, in the *central* area the difference in alpha suppression of *pain* minus *no pain* was similarly (meaning not significantly different) suppressed for *original colored White* ( $M = -0.41$ ,  $SE = .15$ ) and for *violet colored White* ( $M = -0.64$ ,

$SE = .32$ ),  $t(67) = 0.68$ ,  $p = .249$  (one-tailed),  $r = .08$ , in the *parietal* area the difference in alpha suppression of *pain* minus *no pain* was similarly suppressed for *original colored White* ( $M = -0.42$ ,  $SE = .16$ ) and for *violet colored White* ( $M = -0.76$ ,  $SE = .35$ ),  $t(67) = 0.92$ ,  $p = .180$  (one-tailed),  $r = .11$ , in the *frontal* area the difference in alpha suppression of *pain* minus *no pain* was similarly suppressed for *original colored White* ( $M = -0.32$ ,  $SE = .13$ ) and for *violet colored White* ( $M = -0.39$ ,  $SE = .23$ ),  $t(67) = 0.25$ ,  $p = .400$  (one-tailed),  $r = .03$ , as well as in the *occipital* area the difference of *pain* minus *no pain* was similarly suppressed for *violet colored White* ( $M = -0.26$ ,  $SE = .12$ ) and for *original colored White* ( $M = -0.66$ ,  $SE = .38$ ),  $t(67) = 0.99$ ,  $p = .163$  (one-tailed),  $r = .03$ .

Importantly, as predicted, only in the *central* area was the difference in alpha suppression of *pain* minus *no pain* significantly more suppressed for *violet colored Black* ( $M = -0.45$ ,  $SE = .10$ ) than for *original colored Black* ( $M = -0.12$ ,  $SE = .10$ ),  $t(67) = 2.13$ ,  $p = .018$  (one-tailed), which almost represented a medium-sized effect  $r = .25$ . This however, is not found for any other of the areas: In the *parietal* area the difference in alpha suppression of *pain* minus *no pain* was not significantly more suppressed for *violet colored Black* ( $M = -0.35$ ,  $SE = .14$ ) than for *original colored Black* ( $M = -0.03$ ,  $SE = .12$ ),  $t(67) = 1.61$ ,  $p = .056$  (one-tailed),  $r = .07$ , in the *frontal* area the difference in alpha suppression of *pain* minus *no pain* was not significantly more suppressed for *violet colored Black* ( $M = -0.35$ ,  $SE = .10$ ) than for *original colored Black* ( $M = -0.22$ ,  $SE = .09$ ),  $t(67) = 0.92$ ,  $p = .180$  (one-tailed),  $r = .11$ , as well as in the *occipital* area the difference in alpha suppression of *pain* minus *no pain* was not significantly more suppressed for *violet colored Black* ( $M = -0.08$ ,  $SE = .13$ ) than for *original colored Black* ( $M = -0.03$ ,  $SE = .11$ ),  $t(67) = 0.69$ ,  $p = .244$  (one-tailed),  $r = .11$ .

Very importantly, regarding the effect sizes, the difference of *pain* minus *no pain* comparing *original colored White* to *violet colored White* did not represent a small sized effect in the *central*, *parietal*, *frontal* or *occipital* area. In comparison though, the difference of *pain* minus *no pain* comparing *original colored Black* to *violet*

*colored Black* did almost represent a medium-sized effect in *central* areas, but only not a small-sized effect in *parietal* areas and only a small-sized effect in *frontal* and *occipital* areas.

In conclusion, the first assumption of the “Empathy for Pain x Race - Hypothesis” was supported by the results. The difference in alpha suppression of *pain* minus *no pain* was more suppressed for *original colored White*, *violet colored White* and *violet colored Black* than for *original colored Black* and that this interaction revealed itself in the *central* area. In the *parietal* area, we only found support for this hypothesis in that *original colored White* was more suppressed than *original colored Black*. In the frontal area, we did not find any significant results. In the occipital area, surprisingly, *original colored White* was more suppressed than *original colored Black*, but this result may have only become significant due to visual processing.

Second, we tested the assumption of the “Empathy for Pain x Race - Hypothesis”, that since participants watched stimuli showing right hands, this interaction should be even stronger over the *left* hemisphere than over the *right* hemisphere due to lateralized resonance. In fact, when not assessing the *central* area averaged across all sides, but only assessing the *central* area on the *left* side, results were even more pronounced (see Figure 14): In the *central* area on the *left* side, the difference in alpha suppression of *pain* minus *no pain* was significantly more suppressed for *original colored White* ( $M = -0.49$ ,  $SE = .99$ ) than for *original colored Black* ( $M = -0.08$ ,  $SE = .11$ ),  $t(36) = 2.13$ ,  $p = .019$ , which represented a medium-sized effect  $r = .33$ . Also, the difference in alpha suppression of *pain* minus *no pain* was significantly more suppressed for *violet colored Black* ( $M = -0.45$ ,  $SE = .10$ ) than for *original colored Black* ( $M = -0.82$ ,  $SE = .11$ ),  $t(68) = 2.30$ ,  $p = .012$ , which represented almost a medium-sized effect  $r = .27$ . In conclusion, the second assumption of the “Empathy for Pain x Race - Hypothesis” was only somewhat supported by the results. More suppression was found when only assessing the *central* area on the *left* side than when assessing the *central* area averaged across all sides, but only a tendency was found for more suppression in the *left central* side than the *right central* side.

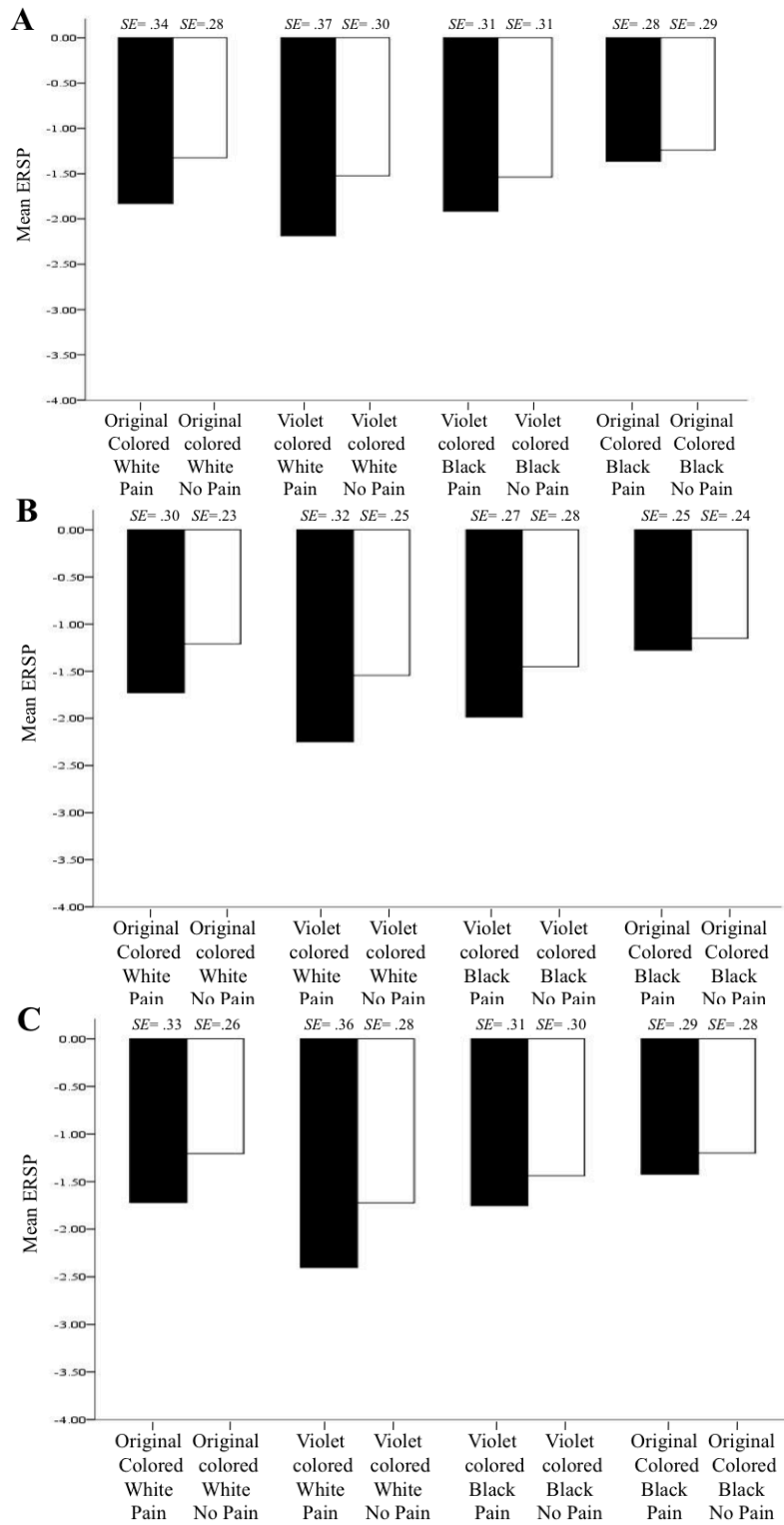


Figure 14.

(A) Empathy for pain x race x familiarity for the *central* area and *left* side

(B) Empathy for pain x race x familiarity for the *central* area and *middle* side

(C) Empathy for pain x race x familiarity for the *central* area and *right* side.

## **4.4 Results for Correlations between EEG and Behavioral Measurements**

### **Results for Correlation between EEG Measurements Evaluations assessing EEG Stimuli**

Indeed, the 12<sup>th</sup> hypothesis (H12) was supported in regard to the ratings of painfulness and unpleasantness of the EEG stimuli: There was a significant relationship between alpha suppression measured with EEG (calculated by subtracting the difference of *original or violet colored Black pain* minus *original or violet colored Black no pain* from the difference of *original or violet colored White pain* minus *original or violet colored White no pain*) and the rating of how painful the situation was for the person whose hand was penetrated by a needle or touched by a Q-tip, (calculated by subtracting the difference of *original or violet colored Black pain* minus *original or violet colored Black no pain* from the difference of *original or violet colored White pain* minus *original or violet colored White no pain*),  $r_s = .20$ ,  $p = .043$  (one-tailed). Also, there was a significant relationship between alpha suppression measured with EEG and the rating of how unpleasant it was for the participants to watch the situation (calculated by subtracting the difference of *original or violet colored Black pain* minus *original or violet colored Black no pain* from the difference of *original or violet colored White pain* minus *original or violet colored White no pain*),  $r_s = .22$ ,  $p = .033$  (one-tailed).

However, alpha suppression measured with EEG was not correlated with believability of the EEG stimuli,  $r_s = .10$ ,  $p = .205$  (one-tailed), and prosocial behavior in response to the EEG stimuli (H13),  $r_s = .04$ ,  $p = .373$  (one-tailed).

## **Results for Correlation between EEG Measurements**

### **Explicit Empathy**

The 14<sup>th</sup> hypothesis (H14) was supported in that there was a significant relationship between neurological empathy for pain (calculated by subtracting *no pain* from *pain*) and one's own personal distress when observing others in need,  $r_s = .22, p = .031$  (one-tailed).

Also, there was a tendency for a significant relationship to be found between neurological empathy for pain (calculated by subtracting *no pain* from *pain*) and one's empathic concern when observing others in need,  $r_s = .17, p = .079$  (one-tailed). As well as, a tendency for a significant relationship between neurological empathy for pain (calculated by subtracting *no pain* from *pain*) and one's ability to identify with others,  $r_s = .16, p = .094$  (one-tailed).

There was no significant relationship between neurological empathy for pain (calculated by subtracting *no pain* from *pain*) and one's perspective taking abilities,  $r_s = -.07, p = .271$  (one-tailed).

We also found a significant correlation between EEG data and the amount of empathic concern, which describes other-oriented feelings of concern that one has when observing others in need. There was a significant relationship between alpha suppression measured with EEG (calculated by subtracting the difference of *original or violet colored Black pain* minus *original or violet colored Black no pain* from the difference of *original or violet colored White pain* minus *original or violet colored White no pain*) and ratings of empathic concern,  $r_s = .26, p = .014$  (one-tailed).

## **Results for Correlation between EEG Measurements Implicit Racial Bias and Explicit Racial Bias**

In regard to the 15<sup>th</sup> hypothesis (H15) no significant relationships were found between the neurological racial bias (calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*) and implicit racial bias measured with the IAT,  $r_s = .17, p = .158$  (one-tailed), implicit racial bias measured with the AMP,  $r_s = -.02, p = .449$  (one-tailed), White preference,  $r_s = .02, p = .448$  (one-tailed), feelings for Whites,  $r_s = .01, p = .472$  (one-tailed), feelings for Blacks,  $r_s = -.15, p = .179$  (one-tailed), feelings for White minus feelings for Blacks,  $r_s = .15, p = .181$  (one-tailed), attitudes towards Blacks,  $r_s = .14, p = .197$  (one-tailed), internal motivation to respond without prejudice,  $r_s = .02, p = .443$  (one-tailed), or external motivation to respond without prejudice,  $r_s = -.13, p = .211$  (one-tailed).

## **Results for Correlation between EEG Measurements Explicit Familiarity**

The 16<sup>th</sup> hypothesis (H16) was supported in that there was a relationship between neurological racial bias (calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*) and the pleasantness and perceived benefit of past and future interactions with Blacks in business settings,  $r_s = -.48, p = .002$ .

The relationships between neurological racial bias (calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*) and current contacts,  $r_s = -.13, p = .421$ , past contacts,  $r_s = -.05, p = .734$ , past friends,  $r_s = .21, p = .205$ , intimacy,  $r_s = -.00, p = .990$ , personal outcomes,  $r_s = .01, p = .936$ , and social outcomes,  $r_s = .08, p = .635$ , were not significant.

## **Results for Correlation between EEG Measurements Social Desirable Responding**

The 17<sup>th</sup> hypothesis (H17) that there is a relationship between neurological racial bias (calculated by subtracting the difference of *original colored Black pain* minus *original colored Black no pain* from the difference of *original colored White pain* minus *original colored White no pain*) and social desirable responding was neither supported for self-deceptive enhancement,  $r_s = -.15$ ,  $p = .186$  (one-tailed), nor impression management,  $r_s = .12$ ,  $p = .233$  (one-tailed).



## **5. DISCUSSION**



## 5. DISCUSSION

### 5.1 Interpretation of Main Results

The research question this study aimed to address is whether alpha desynchronization during empathy for pain is modulated by racial group membership. Previous studies exploring similar questions were helpful in shaping our research question. For example, Yang et al. (2008), Perry et al. (2010) and Whitmarsh et al. (2011) found more alpha desynchronization during empathy for pain. Second, using fMRI Xu et al. (2009) found that racial group membership modulated affective components during empathy for pain. Lastly, using TMS Avenanti et al. (2010) found that racial group membership modulated motor components during empathy for pain. However, to our knowledge no one has yet studied whether racial group membership modulates somatosensory components during empathy for pain. We argue that the alpha desynchronization we assess can be interpreted as somatosensory alpha desynchronization, because our pain stimuli are somatosensory in their nature, because we mainly find somatosensory desynchronization in the time window 2 in which no motion is present in our stimuli and because other research from our field also defend interpretations of suppressed somatosensory oscillations and somatosensory desynchronization (Stancák, 2006; Cheng et al., 2008; Whitmarsh, et al., 2011).

In our study White participants watched video clips of a hand being penetrated by a needle (*pain*) or being touched by a Q-tip (*no pain*). These hands either belonged to a White (*White*) or a Black (*Black*) person. Since Avenanti et al. (2010) argued that the lesser empathy for pain response for out-groups compared to in-groups might not be caused by racial bias but could also simply stem from less familiarity with out-groups, we replicated Avenanti et al. (2010) including control groups with unfamiliar digitally *violet colored White* and *Black* stimuli. In a first EEG session, participants watched *pain* and *no pain* stimuli from *original colored White* and *original colored*

*Black* hands. In a second EEG session, a new group of participants watched *pain* and *no pain* stimuli with *violet colored White* and *violet colored Black* hands. Our main hypothesis was that the difference in alpha suppression of *pain* minus *no pain* is more suppressed for *original colored White*, *violet colored White* and *violet colored Black* than for *original colored Black*. Further, we hypothesize that this interaction reveals itself in somatosensory desynchronization, and therefore should be significant in *central* areas, with some potential *parietal* involvement, but should not be significant in *frontal* and *occipital* areas. Also, since participants watched stimuli showing right hands, this interaction should be even stronger over the *left* hemisphere than over the *right* hemisphere due to lateralized resonance.

After comparing the baseline of 500 ms pre-stimulus (showing a fixation cross) to the time of 3250 - 4250 ms post-stimulus (showing a hand being penetrated by a needle or touched by a Q-tip) we found no tendency for a significant interaction of empathy for pain x race x familiarity x area x side. Nevertheless, à-priori planned t-Tests revealed the predicted assumptions.

In the *central* area, more alpha desynchronization for the difference of *pain* minus *no pain* was found for *original colored White* than for *original colored Black*. Interpreting this, one could conclude that racial group membership modulates empathy for pain. In accordance with our result, when assessing the difference of *pain* minus *no pain* in the first dorsal interosseous muscle with TMS Avenanti et al. (2010) reported finding a more inhibited MEP amplitude for stimuli depicting in-group members than for stimuli depicting out-group members. However, since this result does not control for the factor of familiarity, more tests were conducted introducing the unfamiliar *violet colored White* and *violet colored Black* groups.

In line with this topic, in the *central* area alpha desynchronization for the difference of *pain* minus *no pain* was not significantly different for *violet colored White* and *violet colored Black*. Hence, since participants from the second EEG session did not significantly differentiate between *violet colored White* and *violet colored Black*

*stimuli* it implies that the original stimuli colors did not show through the violet color enough for the White participants to have more empathy for pain for *violet colored White* than for *violet colored Black*. Avenanti et al. (2010) did not differentiate between violet colored in-group stimuli and violet colored out-group stimuli and we found it important to make that distinction.

Moreover, in the *central* area alpha desynchronization for the difference of *pain* minus *no pain* was not significantly different for *original colored White* and for *violet colored White*. Differently, Avenanti et al. (2010) report a finding of a more inhibited AMP amplitude for stimuli depicting in-group members than for stimuli depicting violet colored in- and out-group members. This might be explained by considering that in Avenanti et al.'s (2010) study, participants watched the originally colored White and Black stimuli in a first EEG session, and then the same participants watched the violet colored White and Black stimuli in a second session. Hence, participants might have been able to guess that the violent hands from the second session were simply colored versions of the same hands from the first session, and therefore showed more inhibition for violet colored White than violet colored Black stimuli. If this is the case, then it explains why when violet colored White and violet colored Black stimuli were analyzed as one violet group, they found more inhibition for the in-group than the violet group.

More pertinent to our central question, in the *central* area more alpha desynchronization for the difference of *pain* minus *no pain* was found for *violet colored Black* than for *original colored Black* stimuli. This result supports the conclusion that the lesser empathy for pain response for racial out-groups is caused by racial bias and does not simply stem from less familiarity with out-groups in general. In accordance with this result, Avenanti et al. (2010) also found a more inhibited MEP amplitude for stimuli depicting violet colored in- and out-group members than for racial out-group members.

These results for the *central* area lead us to conclude that our main hypothesis was supported, and that alpha desynchronization during empathy for pain is modulated substantially by racial group membership. In order to validate that the desynchronization we measured actually can be interpreted as somatosensory desynchronization we repeated the above mentioned four planned t-Tests for the other areas. If our conclusion about somatosensory desynchronization is correct then we should only find the predicted empathy for pain x race x familiarity interaction in *central* or *parietal* areas, but not in *frontal* or *occipital* areas. Indeed, for the *frontal* area none of the planned t-Tests were significant. The only significant result found for the *parietal* and *occipital* area was that more alpha desynchronization for the difference of *pain* minus *no pain* was found for *original colored White* than for *original colored Black*. Other studies (for example Perry et al., 2011) have also found increased alpha suppression during empathy for pain in *occipital* areas and have concluded that it may only represent visual processing. Therefore, we do not believe that this alpha suppression in the *occipital* area disproves our hypothesis. In general though, given the low spatial resolution of EEG, we cannot unequivocally interpret the alpha desynchronization as somatosensory alpha desynchronization.

In our final result we found only a tendency for the empathy for pain x race x familiarity interaction to be more pronounced on the *left* side than on the *right* side. We had assumed a greater affect due to lateralized resonance, as participants would be seeing a right hand in stimuli videos.

Besides the empathy for pain x race x familiarity interaction when comparing the baseline of 500 ms pre-stimulus (showing a fixation cross) to the time of 3250 - 4250 ms (showing a hand being penetrated by a needle or touched by a Q-tip), we also found a significant main effect of empathy for pain, and an interaction between empathy for pain and area. Planned t-Tests revealed that more alpha desynchronization was found for *pain* than for *no pain* in *frontal*, *central*, *parietal* and *occipital* areas. These results are contradictory to the results of Yang et al.

(2008), Perry et al. (2010) and Whitmarsh et al. (2011) who found more alpha suppression for *pain* than for *no pain* only in *central* and *frontal* areas.

Turning to the discussion of behavioral results, we found that compared to *no pain* stimuli, *pain* stimuli were indeed judged as more *painful* for the subjects in the videos and as more *unpleasant* for the participants to watch. Even though the behavioral results only showed very limited support that the ratings of painfulness and unpleasantness are higher for *original colored White*, *violet colored White* and *violet colored Black* than for *original colored Black*, we did find a significant correlation between the EEG data and ratings of painfulness and unpleasantness. Participants who for the difference of *pain* minus *no pain* showed more alpha suppression for *original* or *violet colored White* stimuli than for *original* or *violet colored Black* stimuli, also demonstrated for the difference of *pain* minus *no pain* higher ratings of painfulness or unpleasantness for *original* or *violet colored White* stimuli than for *original* or *violet colored Black* stimuli. This can be considered a manipulation check. Even if participant's reactions resulted from predominately pre-conscious conditions, they still employed cognitive and executive functions. This suggests a strong link between our neurological findings and behavioral findings in regard to how participant's empathy for pain response is modulated by racial group membership.

Furthermore, a significant correlation was found between EEG data and personal distress, which describes self-oriented feelings of distress one has when observing others in need. Moreover, a tendency for a significant correlation was found between EEG data and one's amount of empathic concern as well as one's perspective taking abilities. Summarizing all these results, participants who demonstrated more alpha desynchronization for *pain* than for *no pain* also represented themselves as having more feelings of personal distress when observing others in need and showed a tendency to also have greater empathic concern and perspective taking abilities. This was also supported by behavioral results which demonstrated that the higher ratings of painfulness for the difference of *pain* minus *no pain*, the higher one's ability to identify with others; and the higher ratings of unpleasantness for the difference of

*pain* minus *no pain*, the higher ratings of empathic concern and personal distress. These findings relate to Batson et al.'s (1987) model which explains that seeing someone else in distress can either cause one to feel the emotions of personal distress and concern for oneself, or it can cause oneself to feel the emotion of empathy and concern for the other person in need. Our findings seem to indicate that participants who showed a greater extent of empathy for pain demonstrated both tendencies to reply either with personal distress or with empathic concern when seeing others in need. As the other results of this study show, one factor that could decide whether one reacts to seeing someone in need with empathic concern or personal distress is whether one observes an in- or an out-group member.

We also found a significant correlation between EEG data and the amount of empathic concern, which describes other-oriented feelings of concern that one has when observing others in need. Participants who for the difference of *pain* minus *no pain* showed more alpha suppression for *original* or *violet colored White* stimuli than for *original* or *violet colored Black* stimuli, also showed higher ratings of empathic concern. Hence, it is possible to infer that if an individual is particularly prone to feel empathic concern, they are also likely to show more empathy for pain for in-group than for out-group members. This is a particularly interesting finding because empathic concern is considered an important predictor of whether seeing a conspecific in need will result in helping behavior (Batson et al., 1987, Lamm et al., 2007). If one has extraordinary high empathic concern for in-group members, then one would also show more helping behavior towards in-group members. In fact, we attempted to include a measurement of prosocial behavior which asked participants to prepare envelopes for donations which would benefit White or Black patients. Results showed though that participants generally decided to help both White and Black patients. However, this might have been caused by a very low validity of this measurement, as participants did not seem to believe that they would actually have to prepare these envelopes after the experiment.



Surprisingly, no significant correlation was found between EEG data and measurements of implicit or explicit racial bias. One reason for this could be that even though participants clearly demonstrated a racial bias in the EEG experiments, they inhibited this racial bias when explicitly having to answer questions about prejudice and stereotypes. Very interestingly, a significant correlation was found that the higher ratings of unpleasantness for the difference of *pain* minus *no pain* for *original colored White* stimuli than for *original colored Black* stimuli were, the less White preference and colder feelings for Blacks were reported. Moreover, a tendency for a significant correlation was found that the higher ratings of painfulness for the difference of *pain* minus *no pain* for *original colored White* stimuli than for *original colored Black* stimuli were, the colder feelings towards Blacks, more negative attitudes towards Blacks and less implicit motivation to respond without prejudice were reported.

In regard to whether EEG data and explicit measures of familiarity would correlate in a positive or negative way, one could argue that more familiarity or contact with out-groups could decrease stereotypes and prejudices, but also that more familiarity or contact with these out-groups could increase stereotypes and prejudices. The one significant result we found was that participants who showed more alpha suppression for the difference of *pain* minus *no pain* for *original colored White* stimuli than for *original colored Black* stimuli also demonstrated less pleasantness and perceived benefit of past and future interactions with Blacks in business settings. In regard to behavioral results it was also found that the higher ratings of painfulness for the difference of *pain* minus *no pain* for *original colored White* stimuli than for *original colored Black* was and the higher ratings of unpleasantness for the difference of *pain* minus *no pain* for *original colored White* stimuli than for *original colored Black* stimuli was, the more current contact with Blacks was reported.

## **5.2 Ideas for Future Research**

Six ideas for future research evolved during the project for my master thesis.

First, one could study whether dangerous situations as compared to not dangerous situations increase the likelihood of being more concerned for one's racial in-group than a racial out-group. To explore this concept, one could replicate our experiment with the addition of one group that has been exposed to a dangerous situation prior to the experiment (for instance, a loud explosive sound in the room) and one that has not been exposed to such a dangerous situation. A compatible hypothesis would be that for participants who have been primed with the dangerous stimuli compared to participants who have not been primed this way, empathy for pain is modulated by racial group membership to a greater degree.

Second, we predicted that participants who showed more empathy for pain for in-group members than for out-group members would also demonstrate more prosocial behavior towards in-group members than out-group members. However, we did not find any such correlation due to the low validity of the prosocial measurement we created. It would be an immense contribution to the field of empathy research if one would create a valid measurement for prosocial behavior. Then one could also assess whether one is likely to demonstrate more prosocial behavior for one's racial in-group than out-group.

Third, we conducted our experiment with Austrian and German White participants who observed Whites as racial in-group members and Blacks as racial out-group members. Since most research on stereotypes and prejudices has been conducted in the United States of America where tensions between White Americans and Afro-Americans are a prominent topic, most research on racial group membership has focused on these two races. However, it would be useful and interesting to replicate our study with other races as in- and out-group members.

In line with this topic, it would be useful to assess whether empathy for pain is modulated by other group differences besides racial group membership, differences that at times might be regarded as more important than racial group membership. For instance, it would be intriguing to assess if soldiers from the United States Army would show a high extent of empathy for pain for fellow soldiers from their nation regardless of the skin color, and/or a low extent of empathy for pain for soldiers from nations they are currently fighting in war, even if these enemies have the same skin color as the participants.

Further, some methodological issues of our study could be explored further. One such issue is that some participants mentioned that in regard to the EEG stimuli, they experienced the *Black* hand as more unattractive than the *White* hand. Other participants mentioned they guessed the *Black* hand was the hand from a woman and the *White* hand was the hand from a man. In order to ensure that the factors of attractiveness or sex ascribed to the EEG stimuli does not influence our findings, one could replicate our study with new stimuli who control for these factors.

Last, some methodological issues which arouse during the process of EEG analysis could be explored further. We found the empathy for pain x race x familiarity interaction only to be significant when comparing the baseline of 500 ms pre-stimulus to the time of 3250 - 4250 ms post-stimulus which shows a hand being penetrated by a needle or touched by a Q-tip. However, we did not find this result when comparing the same baseline to the time of 2000 - 3000 ms post-stimulus which shows a needle or a Q-tip moving towards the hand. Therefore, one could study in more detail whether alpha desynchronization in general is enhanced during empathy for pain when one is observing a hand actually being penetrated by a needle or touched by a Q-tip than when one is merely observing a hand about to be penetrated by a needle or touched by a Q-tip. Further, we focused our analysis on determining the time of 500 ms pre-stimulus in which a fixation cross is presented as our baseline because we wanted our results to be comparable to other recent studies from our research field (Yang et al., 2008, Perry et al., 2010, Whitmarsh et a., 2011). However, one could

also choose to determine a time as baseline in which a hand without a needle or Q-tip is presented. This change in protocol would lesson the expected difference between alpha suppression between the fixation cross and the stimuli video, thought to arise from the visual processing difference between the simplistic fixation cross video as compared to the visually complex stimuli video. Finally, we concentrated on studying the frequency band alpha, mainly because it is established to study alpha during empathy for pain (Yang et al., 2008, Perry et al., 2010, Whitmarsh et a., 2011). One could also investigate other frequency bands such as beta or theta and compare the results among the various frequency bands, looking for correlations suggestive of empathy for pain.

### **5.3 Theoretical and Practical Implications**

As discussed in great detail in this thesis, the phenomenon of having more empathy for pain for one's racial in-group than racial out-groups can be explained from an evolutionary perspective. It is hypothesized that empathizing allows oneself to live in social groups and strive from evolutionary advantages that this brings with it - such as being safer from predators and danger, being cared for from birth by other members of the group and having rewarding emotions of affiliation and love for others. However, in regard to this evolutionary interpretation one has to point out that when empathy began to develop people lived in rather small social groups. Modernity requires people to belong to much larger social groups ranging from neighborhoods, to cities, states and countries. Hence, for a large social group, it is very maladaptive if members disassociate from each other due to their racial group membership. The United States, a country defined by migration and immigration, is a particularly good example of how important, but often difficult it is for racial groups to understand each other and live in peace. Also, for other countries the subject of immigration is becoming of greater and greater importance. In Germany recently, neo-nazis committed crimes against immigrants and citizens with an immigrant background, unacceptable and frightening crimes in an otherwise modernized German society. Research on empathy and how empathy is modulated by racial group membership can help the development of social programs and policies aimed at improving empathy abilities between racial groups and reduce the negative affects of stereotyping and prejudice. One can name many fields in which such social programs and policies can be realized, such as schools, universities or businesses. Also, the field of clinical psychology can profit from considering our research. Culturally sensitive psychotherapies for minorities assess what culture the client is identifying with and how symptoms and diagnoses manifest themselves in these cultures. If therapists know in advance that they might have less empathy for patients from racial out-groups, then it may be easier to identify thoughts and feelings working against the therapy, which can ultimately increase their effectiveness as clinicians.



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## **APPENDICES**



## **A. Informed Consent to Participate in an EEG Study**

### **Probandeninformation und Einverständniserklärung zur EEG-Ableitung**

Wir laden Sie ein, an unser Studie als freiwillige(r) Proband(in) teilzunehmen.

Im Rahmen dieser Studie soll die Hirnaktivität in Zusammenhang mit der gestellten Aufgabe untersucht werden. Ziel der Studie ist, den zeitlichen Ablauf bestimmter Verarbeitungsschritte zu erfassen und aufzuklären, welche Gehirnareale für die beteiligten Prozesse zuständig sind.

### **Was ist ein EEG?**

Mit Hilfe der Elektroenzephalographie (EEG) wird auf nicht-invasive Weise die vom Gehirn ausgehende elektrische Aktivität von der Kopfhaut abgeleitet. Diese Aktivität entsteht durch die ständige Signalübertragung der Nervenzellen untereinander. Die Aktivität der Nervenzellen in den verschiedenen Regionen des Gehirns unterscheidet sich je nach Art der Aufgabe, die das Gehirn gerade durchführt (z.B. Sprechen, Kopfrechnen, Gedächtnis). Das EEG kann somit über verschiedenste Funktionen des Gehirns Aufschluss geben.

Dabei werden Elektroden auf der Kopfhaut plaziert, die Veränderungen in der elektrischen Spannung des Grosshirns kontinuierlich erfassen und aufzeichnen. Die aufgezeichneten Signale werden dann verstärkt, über viele Durchgänge hinweg gemittelt, und schließlich mit Hilfe statistischer Verfahren ausgewertet.

### **Ablauf der Studie**

Vor der eigentlichen EEG-Messung (die Dauer variiert zwischen 45 Minuten und 1,5 Stunden) werden insgesamt 64 EEG-Elektroden am Kopf, über und neben dem rechten und linken Auge sowie am Schlüsselbein und im Genick angebracht (Applikationsdauer ca. 1 Std.). Um den Übergangswiderstand zwischen Haut und

Elektrode möglichst gering zu halten, wird dort, wo die Elektroden sitzen, die oberste Hautschicht mit einer sterilen Nadel leicht angekratzt. Das fühlt sich etwa so an, wie wenn man mit dem Fingernagel an der Kopfhaut kratzt. Der Versuchsraum ist mit einer Überwachungskamera mit dem Kontrollraum verbunden, sodass Sie immer mit den Versuchsleitern Kontakt aufnehmen können.

Während der Messung werden Ihnen über den Bildschirm Aufgaben präsentiert, die Sie möglichst gut und konzentriert lösen sollen.

### **Risiken und Unannehmlichkeiten der Untersuchung:**

Die EEG-Messung ist schmerzfrei und ohne Gesundheitsrisiko. Sämtliche mit der Haut in Kontakt kommende Materialien sind desinfiziert. Die für die Applikation verwendeten Chemikalien (Elektrodenpaste, Desinfektionsmittel) sind in den verwendeten Konzentrationen und Dosierungen gesundheitlich unbedenklich.

Es werden nur an der Kopfhaut vorhandene elektrische Ströme abgeleitet, die vom Gehirn produziert werden. Es wird keinerlei Strom zugeführt. Durch speziell geerdete Geräte besteht keine Gefahr elektromagnetischer Induktion.

### **Ihre Rechte:**

Selbstverständlich können Sie vor und jederzeit während der Untersuchung weitere Informationen über Zweck, Ablauf, etc. der Studie von den durchführenden Personen erfragen. Sie können die Studie jederzeit, auch ohne Angabe von Gründen und ohne dass sich für Sie daraus Nachteile ergeben, von sich aus abbrechen.

### **Teilnahmebeschränkungen:**

Sie dürfen nicht an der Untersuchung teilnehmen, wenn Sie:

- 1.) Brüche (Schädelbruch) oder Implantate am Kopf haben oder hatten,
- 2.) Ekzeme oder Muttermale auf der Kopfhaut oder allgemein leicht reizbare Haut am Kopf haben,
- 3.) eine ansteckende Blutkrankheit (z.B. HIV) haben,
- 4.) Angst vor Nadeln haben,
- 5.) an Diabetes oder Blutkrankheit leiden,



- 6.) eine neurologische Erkrankung haben (z.B. Schwindelanfälle, Epilepsie),  
7.) regelmäßig Psychopharmaka einnehmen.

**Datenschutz:**

Sämtliche Ihre Person betreffenden Daten werden getrennt von den bei Ihnen erhobenen EEG-Daten (und getrennt von eventuellen Fragebögen) aufbewahrt, so dass Ihre Anonymität stets gewahrt bleibt. Die bei Ihnen erhobenen Daten fließen in eine Gruppenanalyse ein, deren Ergebnisse in einer wissenschaftlichen Zeitschrift veröffentlicht werden sollen.

**Einverständniserklärung**

Durch Ihre Unterschrift bestätigen Sie, dass Sie die Patienteninformation gelesen und verstanden haben. Sie erklären sich mit der Teilnahme an dieser Studie sowie der Analyse ihrer Daten durch befugte Personen einverstanden.

Sie wurden darauf hingewiesen, dass Sie den Anweisungen der studierendurchführenden Mitarbeiter im Interesse Ihrer eigenen Sicherheit nachkommen sollen und dass ein Verschweigen von bestehenden Krankheitszuständen oder der Studie unmittelbar vorangegangenen Medikamenteneinnahme Ihre eigene Sicherheit gefährden kann.

Name:

\_\_\_\_\_

Geboren am:

\_\_\_\_\_

Datum:

\_\_\_\_\_

Unterschrift:

\_\_\_\_\_

Ich bestätige, dass ich oben genannte(n) ProbandIn über Zweck und Art der Studie informiert habe:

Name des Untersuchungsleiters:

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Unterschrift:

---

Datum:

---

## B. Edinburgh Inventory (Oldfield, 1971)

### Edinburgh Händigkeits-Inventar

Name:

---

Geburtsdatum:

---

Bitte geben Sie an, welche Hand Sie für die folgenden Aktivitäten bevorzugt verwenden, indem Sie ein + in die entsprechende Spalte schreiben. Markieren Sie bitte die Fälle, in denen Sie nie die andere Hand verwenden würden, außer Sie wären absolut dazu gezwungen, mit ++. Für Fälle, in denen Sie keine Hand bevorzugt verwenden, schreiben Sie + in beide Spalten. Einige Aktivitäten erfordern beide Hände. In diesen Fällen wird auf den Teil der Aufgabe oder des Objektes, für den Sie die bevorzugte Hand angeben sollen, in Klammern hingewiesen. Bitte bemühen Sie sich, alle Fragen zu beantworten. Lassen Sie eine Frage nur dann aus, wenn Sie gar keine Erfahrung mit der Aufgabe oder dem Objekt haben.

		LINKS	RECHTS
1	Schreiben		
2	Zeichnen		
3	Werfen		
4	Schere		
5	Zahnbürste		
6	Messer (ohne Gabel)		
7	Löffel		
8	Besen (obere Hand)		
9	Streichholz anzünden		
10	Schachtel öffnen (Deckel)		

## **C. Instructions for EEG Assessment**

### **Erster Bildschirm**

Willkommen!

Vielen Dank, dass Sie an unserem EEG-Experiment teilnehmen!

Zum Ablauf:

Die EEG-Aufzeichnung wird ca. 45 Minuten dauern.

Danach werden die VersuchsleiterInnen Ihnen noch ein paar andere Tests und Fragebögen geben. Dies wird noch einmal ca. 45 Minuten dauern.

...weiter mit dem Drücken einer beliebigen Taste...

### **Zweiter Bildschirm**

Wir hoffen auf gute verwertbare Daten. Dies kann jedoch nur erreicht werden, wenn Sie versuchen während des ganzen Experiments aufmerksam zu sein. Sollten Sie müde werden oder sollten Sie sich überanstrengt fühlen, so nutzen Sie bitte die Pausen. Sie können entscheiden, wie lange die Pausen sind. Beenden Sie eine Pause bitte erst, wenn Sie denken, dass Sie wieder aufmerksam fortfahren können.

Insgesamt gibt es 7 Pausen.

Es wurde viel Arbeit in die Planung dieser Diplomarbeitsstudie investiert. Wir hoffen, dass Sie sich als Versuchsperson anstrengen, damit wir unsere Diplomarbeitsstudie mit Erfolg durchführen können.

Vielen Dank!

...weiter mit dem Drücken einer beliebigen Taste...

### **Dritter Bildschirm**

Sie werden nun vier Videos zur Übung sehen.

...weiter mit dem Drücken einer beliebigen Taste...

### **Vierter Bildschirm**

Sie haben nun noch einmal die Möglichkeit, den VersuchsleiterInnen Fragen zu stellen.

...Wenn Sie bereit sind mit dem Experiment zu beginnen und keine Fragen mehr haben, drücken sie bitte eine beliebige Taste...

## **D. Assessment of Painfulness, Unpleasantness and Believability of Stimuli**

### **Erster Bildschirm**

Sie werden nun noch mal ein paar Videos sehen.

Nach jedem Video werden Ihnen immer 3 Fragen gestellt:

1.) "Wie schmerzhaft für den Menschen?"

Hier sollen Sie einschätzen, wie schmerzhaft die im Video zu sehende Situation für den Menschen war.

2.) "Wie unangenehm für Sie?"

Hier sollen Sie einschätzen, wie angenehm oder unangenehm es für Sie war, das Video anzusehen.

3.) "Wie real war die Situation?"

Hier sollen sie einschätzen, wie echt und real die im Video zu sehende Situation für Sie war.

...weiter mit dem Drücken einer beliebigen Taste...

### **Zweiter Bildschirm**

Wir bitten Sie diese Fragen auf einer siebenstelligen Skala zu beantworten.

Die Taste "1" steht für  
gar nicht schmerzhaft, gar nicht unangenehm oder gar nicht real.

Die Taste "7" steht für  
sehr schmerzhaft, sehr unangenehm oder sehr real.

...weiter mit Drücken einer beliebigen Taste...

## **E. Assessment of Prosocial Behavior**

### **Erster Bildschirm**

Zu ihrer näheren Information:

Die Videos, die Sie gerade gesehen haben, zeigten Patienten. Diese erhielten sehr wichtige Injektionen, welche eine schwere Hyperhidrosis Palmaris behandelten.

...weiter mit dem Drücken einer beliebigen Taste...

### **Zweiter Bildschirm**

Würden Sie diese Woche bei dem Eintüten der Briefe helfen, um diesen Patienten weitere wichtige Injektionen zu ermöglichen?

Bitte schauen Sie sich die zwei folgenden Videos an.

Entscheiden Sie bitte dann, ob Sie für den 1. Patienten und/oder für den 2. Patienten Briefe eintüten möchten.

...weiter mit dem Drücken einer beliebigen Taste...

### **Dritter Bildschirm**

Wären Sie bereit Briefe einzutüten?

0 = Nein

1 = 15 Minuten für 1. Patient

2 = 15 Minuten für 2. Patient

3 = 30 Minuten für beide Patienten

4 = 30 Minuten für 1. Patient

5 = 30 Minuten für 2. Patient

6 = 60 Minuten für beide Patienten

7 = 15 Minuten für 1. Patient, 30 Minuten für 2. Patient

8 = 30 Minuten für 1. Patient, 15 Minuten für 2. Patient

## **F. Saarbrücker Persönlichkeitsfragebogen (Paulus, 2009) based on Interpersonal Reactivity Index (Davis, 1980)**

Sie werden jetzt eine Reihe von Aussagen lesen, die jeweils bestimmte (verallgemeinerte) menschliche Eigenschaften oder Reaktionen beschreiben, die alle etwas mit Gefühlen zu tun haben. Bitte kennzeichnen Sie dann auf der 5-Punkte-Skala, inwieweit diese Aussage auf Sie zutrifft; je höher die Zahl, desto höher die Zustimmung. Vielleicht fällt Ihnen auch zu der einen oder anderen allgemeinen Beschreibung ein konkretes Erlebnis ein.

Es gibt dabei keine richtigen oder falschen Antworten (je größer die Zahl 1-5, desto höher ist Ihre Zustimmung).

1 (trifft gar nicht zu) - 2 - 3 - 4 - 5 (trifft sehr zu)

1. Ich empfinde warmherzige Gefühle für Leute, denen es weniger gut geht als mir.
2. Die Gefühle einer Person in einem Roman kann ich mir sehr gut vorstellen.
3. In Notfallsituationen fühle ich mich ängstlich und unbehaglich.
4. Ich versuche, bei einem Streit zuerst beide Seiten zu verstehen, bevor ich eine Entscheidung treffe.
5. Wenn ich sehe, wie jemand ausgenutzt wird, glaube ich, ihn schützen zu müssen.
6. Ich fühle mich hilflos, wenn ich inmitten einer sehr emotionsgeladenen Situation bin.
7. Nachdem ich einen Film gesehen habe, fühle ich mich so, als ob ich eine der Personen aus diesem Film sei.
8. In einer gespannten emotionalen Situation zu sein, beängstigt mich.
9. Mich berühren Dinge sehr, die ich nur beobachte.



10. Ich glaube, jedes Problem hat zwei Seiten und versuche deshalb beide zu berücksichtigen.
11. Ich würde mich selbst als eine ziemlich weichherzige Person bezeichnen.
12. Wenn ich einen guten Film sehe, kann ich mich sehr leicht in die Hauptperson hineinversetzen.
13. In heiklen Situationen neige ich dazu, die Kontrolle über mich zu verlieren.
14. Wenn mir das Verhalten eines anderen komisch vorkommt, versuche ich mich für eine Weile in seine Lage zu versetzen.
15. Wenn ich eine interessante Geschichte oder ein gutes Buch lese, versuche ich mir vorzustellen, wie ich mich fühlen würde, wenn mir die Ereignisse passieren würden.
16. Bevor ich jemanden kritisiere, versuche ich mir vorzustellen, wie ich mich an seiner Stelle fühlen würde.

**G. Stimuli Material of Implicit Association Task (Greenwald, McGee & Schwartz, 1998, reprinted with the first author's permission)**

Black female stimuli:



Black male stimuli:



White female stimuli:



White male stimuli:



## **H. White Preference Thermometer Difference and White Preference Likert (based on Project Implicit of Harvard University, 1998)**

### **White Preference Thermometer Difference**

Bitte geben Sie an, inwiefern Sie positive oder negative Gefühle gegenüber den folgenden Gruppen haben (0 = negative Gefühle; 5 = neutral; 10 = sehr positive Gefühle)

#### **Schwarze Personen**

- 1 (sehr kalt) - 2 - 3 - 4 - 5 (neutral) - 6 - 7 - 8 - 9 - 10 (sehr warm) -

#### **Weißer Personen**

- 1 (sehr kalt) - 2 - 3 - 4 - 5 (neutral) - 6 - 7 - 8 - 9 - 10 (sehr warm) -

### **White Preference Likert**

Welche Aussage trifft am ehesten auf Sie zu?

Bitte auswählen:

- Ich bevorzuge weiße Menschen stark gegenüber schwarzen Menschen. -
- Ich bevorzuge weiße Menschen mittel gegenüber schwarzen Menschen. -
- Ich bevorzuge weiße Menschen ein bisschen gegenüber schwarzen Menschen. -
  - Ich mag weiße Personen und schwarze Personen gleichermaßen. -
- Ich bevorzuge schwarze Menschen ein bisschen gegenüber weißen Menschen. -
- Ich bevorzuge schwarze Menschen mittel gegenüber weißen Menschen. -
- Ich bevorzuge schwarze Menschen stark gegenüber weißen Menschen. -

## **I. Attitudes towards Blacks Scale (Brigham, 1993)**

Dieser Fragebogen besteht aus 20 Fragen, die sich auf ihre Meinungen bezüglich aktueller sozialer Themen beziehen. Bitte antworten Sie auf diese Fragen mithilfe der angegebenen siebenstelligen Skala, bei der 1 = **starke Zustimmung** und 7 = **starke Ablehnung** der Aussage bedeutet. Schreiben Sie eine Zahl von 1 bis 7, welche am besten Ihre Meinung darstellt, auf die Zeile links neben jeder Aussage. Bitte beantworten sie **jede Frage**; und lassen Sie keine aus. Es gibt keine "richtigen" oder "falschen" Antworten; bitte seien Sie so ehrlich und offen, wie Sie können. Alle Antworten werden vertraulich behandelt und nur als Gruppendaten analysiert.

Vielen Dank für Ihre Teilnahme!

1 = stark nicht zustimmen

2 = nicht zustimmen

3 = ein bisschen nicht zustimmen

4 = weder zustimmen noch nicht zustimmen

5 = ein bisschen zustimmen

6 = zustimmen

7 = stark zustimmen

1. Ich genieße einen lustigen rassistischen Witz, auch wenn manche Leute dies vielleicht anstößig finden.
2. Wenn ich die Möglichkeit hätte schwarze Gäste meinen Freunden und Nachbarn vorzustellen, würde ich dies gerne machen.
3. Ich möchte lieber nicht, dass schwarze Menschen in demselben Wohngebäude leben wie ich.
4. Von der Integration von Personen mit verschiedensten Hautfarben (in Schulen, Betrieben, Wohnorten, ect.) haben sowohl weiße als auch schwarze Menschen profitiert.
5. Ich würde mich vermutlich etwas befangen fühlen, mit einem schwarzen

Menschen in der Öffentlichkeit zu tanzen.

6. Ich glaube, dass schwarze Menschen einander ähnlicher sehen als weiße Menschen.
7. Es würde mich nicht stören, wenn mein neuer Mitbewohner/ meine neue Mitbewohnerin schwarz wäre.
8. Einer Ehe, in der die Partner verschiedene Hautfarben haben, sollte abgeraten werden, um die „wer-bin-ich“-Verwirrung, welche die Kinder fühlen werden, zu vermeiden.
9. Wenn mein Vorgesetzter ein schwarzer Mensch wäre, würde es mich nicht stören Ratschläge und Anleitungen von ihm oder ihr anzunehmen.
10. Im Allgemeinen sind schwarze Menschen nicht so klug wie weiße Menschen.
11. Die Regierung sollte entscheidende Schritte gegen Ungerechtigkeiten einleiten, die schwarze Menschen durch ansässige Behörden erleiden.
12. Es ist wahrscheinlich, dass schwarze Menschen Gewalt in Nachbarschaften bringen, wenn sie dort hinziehen.
13. Schwarze und weiße Menschen sind an sich gleich.
14. Es regt mich sehr auf, wenn ich höre, dass ein weißer Mensch eine vorurteilbehaftete Äußerung gegenüber schwarzen Menschen macht.
15. Ich bin besorgt, dass ich in den nächsten Jahren aufgrund der Bevorzugung von Gruppenmitgliedern von Minderheiten einen Job oder eine Beförderung nicht erhalte.
16. Ich bevorzuge Wohnungsgesetze, die mehr Integration von Menschen mit verschiedensten Hautfarben in Nachbarschaften erlauben.
17. Schwarze Menschen fordern zu viel zu schnell in ihrer Bemühung um gleiche Rechte.
18. Es würde mich nicht stören, wenn eine schwarze Familie mit einem mir ähnlichem Einkommen und Bildungsniveau neben mir einziehen würde.
19. Weiße Menschen sollten schwarze Menschen in ihrem Kampf gegen Diskriminierung und Segregation unterstützen.
20. Manche schwarze Menschen sind so empfindlich in Bezug auf ihre Hautfarbe, dass es schwierig ist mit ihnen auszukommen.

## **J. Internal and External Motivation to Respond without Prejudice (Plant & Devine, 1998)**

*Translated in German from original English version:*

Instruktion: Die folgenden Fragen betreffen verschiedenste Gründe und Motivationen, die man haben kann, um unvoreingenommen gegenüber schwarzen Menschen zu sein. Manche dieser Gründe repräsentieren internal-persönliche Motivationen, während andere eher external-soziale Motivationen repräsentieren. Natürlich kann man aufgrund von internaler und externaler Gründe eine gewisse Motivation haben; wir möchten betonen, dass keine der beiden Arten von Motivation besser ist als die andere. Darüber hinaus möchten wir klarstellen, dass wir Sie und Ihre persönlichen Antworten nicht bewerten, alle Ihre Antworten werden vollkommen vertraulich behandelt. Wir möchten uns lediglich ein Bild davon machen, welche Art von Motivationen Studenten im Allgemeinen haben, um unvoreingenommen zu reagieren. Damit wir irgendetwas Nützliches erfahren, ist es wichtig, dass Sie jede Frage offen und ehrlich beantworten. Bitte geben Sie Ihre Antworten entsprechend der vorgegebenen Skalen.

- 1 ( stimme stark nicht zu ) - 2 - 3 - 4 - 5 - 6 - 7 (stimme stark zu) -

1. Aufgrund von der heutigen Standards bezüglich politischer Korrektheit versuche ich nicht voreingenommen gegenüber schwarzen Menschen zu wirken.
2. Ich versuche jegliche negative Gedanken über schwarze Menschen zu verstecken, um negative Reaktionen anderer zu vermeiden.
3. Wenn ich mich voreingenommen gegenüber schwarzen Menschen verhalten hätte, würde ich beunruhigt sein, dass mir andere böse sind.

4. Ich versuche unvoreingenommen gegenüber schwarzen Menschen zu erscheinen, um Missbilligung anderer zu vermeiden.
5. Ich versuche aufgrund von Drängen anderer unvoreingenommen gegenüber schwarzen Menschen zu handeln.
6. Ich versuche unvoreingenommen gegenüber schwarzen Menschen zu handeln, weil es für mich persönlich wichtig ist.
7. Meinen persönlichen Werten nach, ist es in Ordnung Stereotype über schwarze Menschen zu verwenden.
8. Ich bin persönlich durch meine Überzeugungen motiviert, unvoreingenommen gegenüber schwarzen Menschen zu sein.
9. Aufgrund meiner persönlichen Werte glaube ich, dass die Verwendung von Stereotypen gegenüber schwarzen Menschen falsch ist.
10. Unvoreingenommen gegenüber schwarzen Menschen zu sein, ist wichtig für mein Selbstkonzept.

## **K. Social Experiences Questionnaire (Brigham, 1993)**

*Translated in German from original English version:*

Wir werden Sie nun über Ihre persönlichen Erfahrungen mit schwarzen Menschen befragen. Wir interessieren uns nicht für Situationen, in denen Sie einen schwarzen Menschen beobachtet haben, ohne dass dieser auf Sie reagiert hat (z.B. in der Öffentlichkeit). Vielmehr sind wir interessiert an Situationen, in denen Sie Grüße ausgetauscht haben, sich miteinander unterhalten haben, mit einander gearbeitet haben, Informationen oder Dienstleistungen erfragt, erhalten oder gegeben haben, oder in anderer Art miteinander interagiert haben. Wenn Sie beispielsweise einen schwarzen Menschen in einem Restaurant anschauen, handelt es sich nicht um eine Interaktion solange er nicht in einer ähnlichen Weise auf Sie reagiert, z.B. indem er mit ihnen Augenkontakt hat. Ebenso handelt es sich um keine Interaktion, wenn Sie angeschaut werden, ohne dass Sie in einer ähnlichen Weise reagieren.

Wir werden Ihnen in vier Teilen Fragen über ihre persönlichen Erfahrungen mit schwarzen Menschen stellen. Zuerst werden wir ihnen generelle Fragen stellen, gefolgt von Fragen über ihre Interaktionen in beruflichen Situationen, intimen-persönlichen Situationen, und sozialen / öffentlichen Situationen. Danach werden wir Sie fragen, in welchem Ausmaß diese Interaktionen in den verschiedenen Situationen angenehm oder unangenehm waren.

*Wenn nach Prozentangaben gefragt wird, gelten folgende Zahlen:*

- (0) = 0-9%
- (1) = 10-19%
- (2) = 20-29%
- (3) = 30-39%
- (4) = 40-49%
- (5) = 50-59%



- (6) = 60-69%
- (7) = 70-79%
- (8) = 80-89%
- (9) = 90-100%

## GENERAL INFORMATION

1. Circa wie viel Prozent der Schüler Ihrer Grundschule waren schwarze Menschen?
2. Wie viele schwarze Freunde hatten Sie in ihrer Grundschule? (9 = 9 oder mehr)
3. Circa wie viel Prozent der Schüler Ihrer Oberschule (Klasse 4 oder 7 bis Klasse 10) waren schwarze Menschen?
4. Wie viele schwarze Freunde hatten Sie in Ihrer Oberschule (Klasse 4 oder 7 bis Klasse 10)? (9 = 9 oder mehr)
5. Circa wie viel Prozent der Schüler Ihrer Oberschule (Klasse 11 bis Klasse 12 oder 13) waren schwarze Menschen?
6. Wie viele schwarze Freunde hatten Sie in Ihrer Oberschule (Klasse 11 bis Klasse 12 oder 13)? (9 = 9 oder mehr)
7. Circa wie viel Prozent der Menschen in Ihrer Nachbarschaft, in der Sie aufgewachsen sind, waren schwarze Menschen?
8. Über den Zeitraum einer durchschnittlichen Woche, mit circa wie vielen schwarzen Menschen unterhalten Sie sich? (9 = 9 oder mehr)
9. Über den Zeitraum einer durchschnittlichen Woche, mit circa wie vielen schwarzen Menschen unterhalten Sie sich in der Universität? (9 = 9 oder mehr)
10. ... während Freizeitaktivitäten (Sport, Parties, ect.)? (9 = 9 oder mehr)
11. ... in Geschäften? (9 = 9 oder mehr)
12. ... in Studentenwohnheimen oder Wohngebäuden? (9 = 9 oder mehr)
13. Wie viele schwarze Menschen kennen Sie in Österreich bei Vornamen, welche Sie ebenfalls bei Vornamen kennen? (9 = 9 oder mehr)

14. Wie viele von Ihren neun engsten Freunden sind schwarze Menschen?
15. Wie viele Male sind sie mit einem schwarzen Menschen auf ein Date ausgegangen oder waren mit einem schwarzen Menschen in einer Beziehung? (9 = 9 oder mehr)

*Bitte beantworten Sie die folgenden Fragen auf einer siebenstelligen Skala.*

### **BERUFLICHES UMFELD**

1. Im Allgemeinen, wie viel Interaktion haben sie mit schwarzen Menschen im beruflichen Umfeld? (1 = keine; 7 = sehr viel)
2. Durchschnittlich betrachtet, wie *angenehm* oder *unangenehm* waren diese Interaktionen? (1 = sehr unangenehm; 7 = sehr angenehm)
3. Durchschnittlich betrachtet, haben Sie Interaktionen mit schwarzen Menschen im beruflichen Umfeld etwas gekostet oder haben Sie von ihnen profitiert? (1 = kostspielig; 7 = profitabel)
4. Wie *angenehm* oder unangenehm, glauben Sie, werden Interaktionen mit schwarzen Menschen im beruflichen Umfeld in der Zukunft sein? (1 = sehr unangenehm; 7 = sehr angenehm)

### **INTIM-PERSÖNLICHES UMFELD**

1. Im Allgemeinen, wie viel Interaktion haben sie mit schwarzen Menschen im intim-persönlichem Umfeld? (1 = keine; 7 = sehr viel)
2. Durchschnittlich betrachtet, wie *angenehm* oder *unangenehm* waren diese Interaktionen? (1 = sehr unangenehm; 7 = sehr angenehm)
3. Durchschnittlich betrachtet, haben Sie Interaktionen mit schwarzen Menschen im intim-persönlichem Umfeld etwas gekostet oder haben Sie von ihnen profitiert? (1 = kostspielig; 7 = profitabel)
4. Wie *angenehm* oder unangenehm, glauben Sie, werden Interaktionen mit schwarzen Menschen im intim-persönlichem Umfeld in der Zukunft sein? (1 = sehr unangenehm; 7 = sehr angenehm)

## SOZIAL-ÖFFENTLICHES UMFELD

1. Im Allgemeinen, wie viel Interaktion haben sie mit schwarzen Menschen im sozial-öffentlichem Umfeld? (1 = keine; 7 = sehr viel)
2. Durchschnittlich betrachtet, wie *angenehm* oder *unangenehm* waren diese Interaktionen? (1 = sehr unangenehm; 7 = sehr angenehm)
3. Durchschnittlich betrachtet, haben Sie Interaktionen mit schwarzen Menschen im sozial-öffentlichem Umfeld etwas gekostet oder haben Sie von ihnen profitiert? (1 = kostspielig; 7 = profitabel)
4. Wie *angenehm* oder unangenehm, glauben Sie, werden Interaktionen mit schwarzen Menschen im sozial-öffentlichem Umfeld in der Zukunft sein? (1 = sehr unangenehm; 7 = sehr angenehm)

## **L. Balanced Inventory of Desirable Responding (Musch, Brockhaus & Bröder, 2002)**

Geben Sie bitte für jede Aussage an, wie sehr Sie ihr zustimmen, von 1 (= völlige Ablehnung) bis 7 (= völlige Zustimmung). Bitte lassen Sie keine Frage aus.

- 1 (trifft überhaupt nicht zu) - 2 - 3 - 4 - 5 - 6 - 7 (trifft völlig zu) -

1. Der erste Eindruck, den ich von anderen Menschen gewinne, bewahrheitet sich meistens.
2. Ich bin nicht immer mir selber gegenüber ganz ehrlich gewesen.
3. Ich weiß immer, warum ich etwas mag.
4. Es fällt mir schwer, einen beunruhigenden Gedanken beiseite zu drängen.
5. Manchmal verpasse ich etwas, weil ich mich einfach nicht schnell genug entscheiden kann.
6. Ich bin ein vollkommen rational denkender Mensch.
7. Ich kann Kritik selten vertragen.
8. Ich bin mir meiner Urteile sehr sicher.
9. An meinen Fähigkeiten als Liebhaber habe ich schon gelegentlich gezweifelt.
10. Ich weiß nicht immer die Gründe für meine Handlungen.
11. Manchmal lüge ich, wenn ich muss.
12. Es ist schon einmal vorgekommen, dass ich jemanden ausgenutzt habe.
13. Ich fluche niemals.
14. Manchmal zahle ich es lieber anderen heim, als dass ich vergebe und vergesse.
15. Ich habe schon einmal zu viel Wechselgeld bekommen, ohne es der Verkäuferin zu sagen.
16. Ich gebe grundsätzlich alles an, was ich zu verzollen habe.
17. Manchmal fahre ich schneller, als es erlaubt ist.

18. Ich habe Dinge getan, von denen ich anderen nichts erzähle.
19. Ich nehme niemals Dinge an mich, die mir nicht gehören.
20. Ich bin schon einmal wegen einer angeblichen Krankheit nicht zur Arbeit oder Schule gegangen.

## **M. Demographic Information (partly based on the demographic information from Project Implicit of Harvard University, 1998)**

Zum Schluss bitten wir Sie noch einige Angaben zu Ihrer Person zu machen. Selbstverständlich werden auch diese Angaben strengst vertraulich behandelt und können nicht mit Ihrem Namen in Verbindung gebracht werden.

### **Alter**

Bitte auswählen:

18 - 19 - 20 - 21 - 22 - 23 - 24 - 25 - 26 - 27 - 28 - 29 - 30 -  
31 - 32 - 33 - 34 - 35 - 36 - 37 - 38 - 39 - 40

### **Geschlecht**

Bitte auswählen:

weiblich - männlich

### **Ethnischer Hintergrund**

Bitte auswählen:

Europäisch - Ostasiatisch - Südasiatisch - Afrikanisch - Mehrere - Andere oder  
Unbekannt

### **Politische Einstellung**

Bitte auswählen:

stark rechts - gemäßigt rechts - eher rechts - neutral - eher links - gemäßigt links -  
stark links

### **Bevorzugte Partei**

Bitte auswählen:

Österreich: ÖVP - Österreich: SPÖ - Österreich: die Grünen - Österreich: FPÖ -  
Österreich: BZÖ - Österreich: Liberales Forum - Österreich: Kommunistische Partei  
Österreichs - Deutschland: CDU - Deutschland: SPD - Deutschland: die Linke -  
Deutschland: die Grünen - Deutschland: FPD - Andere

### **Religiöse Zugehörigkeit**

Bitte auswählen:

Katholisch - Evangelisch - Jüdisch - Muslimisch - Buddhistisch - Hindu - Sikh -  
Andere - Keine

### **Religiosität**

Bitte auswählen:

sehr religiös - gemäßigt religiös - wenig religiös - überhaupt nicht religiös

### **Bildung**

Bitte auswählen:

Volksschule - Hauptschulabschluss - Berufsbildende Höhere Schule bzw. Lehre -  
Matura oder Fachhochschulreife - Universität oder Fachhochschule ohne Abschluss -  
Magister - Bachelor - Master - Diplom - Promotion - Andere

**Wenn Sie eine Universität besucht haben, geben Sie uns bitte Ihr Hauptfach an  
oder das Fach, in dem Sie Ihren höchsten Abschluss haben.**

Bitte auswählen:

Biologie oder Lebenswissenschaften - Wirtschaftswissenschaften -  
Kommunikationswissenschaften - Informatik - Pädagogik - Physik, Mathematik,  
Ingenieurwissenschaften - Medizin oder Gesundheitswissenschaften -

Geisteswissenschaften oder Studium Generale - Jus - Psychologie -  
Gesellschaftswissenschaften oder Geschichte - Kunst - Andere

**Land / Region Ihres derzeitigen Wohnorts**

Bitte auswählen:

Österreich - Deutschland - U.S.A. - Afghanistan - Albanien - Algerien - Andorra -  
Angola - Anguilla - Antarktis - Antigua und Barbuda - Argentinien - Armenien -  
Aruba - Australien - Aserbaidtschan - Bahamas - Bahrain - Bangladesch - Barbados -  
Belarus - Belgien - Belize - Benin - Bermuda - Bhutan - Bolivien - Bosnien-  
Herzegowina - Botswana - Bouvet Islands - Brasilien - Britisch-Indischer Ozean -  
Brunei - Bulgarien - Burkina Faso - Burundi - Kambodscha - Kamerun - Kanada -  
Kap Verde - Cayman Islands - Zentralafrikanische Republik - Tschad - Chile - China  
- Weihnachtsinsel - Cocos (Keeling) Islands - Kolumbien - Comoros - Kongo -  
Kongo, Demokratische Republik von - Cook Islands - Costa Rica - Elfenbeinküste -  
Kroatien - Kuba - Zypern - Tschechische Republik - Dänemark - Djibouti - Dominica  
- Dominikanische Republik , Ost-Timor - Ecuador - Ägypten - El Salvador -  
Äquatorial-Guinea - Eritrea - Estland - Äthiopien - Falkland Inseln - Faröer Inseln -  
Fidschi Inseln - Finnland - Frankreich - Französisch Guayana - Französisch  
Polynesien - Französische Südprovinzen - Gabun - Gambia - Georgien - Ghana -  
Gibraltar - Griechenland - Grönland - Grenada - Guadeloupe - Guam - Guatemala -  
Guinea - Guinea-Bissau - Guyana - Haiti - Heard and McDonalds Island - Honduras -  
Hong Kong S.A.R. - Ungarn - Island - Indien - Indonesien - Iran - Irak - Irland- Israel  
- Italien - Jamaika - Japan - Jordanien - Kasachstan - Kenia - Kiribati - Korea -  
Nordkorea - Kuwait - Kirgisistan - Laos - Lettland - Libanon - Lesotho - Liberien -  
Lybien - Liechtenstein - Litauen - Luxembourg - Macau S.A.R. - Mazedonien,  
Ehemalige Jugoslawische Republik von - Madagaskar - Malawi - Malaysia -  
Malediven - Mali - Malta - Marshall Islands - Martinique - Mauretanien - Mauritius -  
Mayotte - Mexiko - Mikronesien - Moldawien - Monaco - Mongolei - Montserrat -  
Marokko - Mosambik - Myanmar, früher Birma - Namibia - Nauru - Nepal -  
Niederländische Antillen - Niederlande, Die - Neukaledonien - Neuseeland -  
Nikaragua - Niger - Nigeria - Niue - Norfolk Inseln - Nord Mariana Inseln -



Norwegen - Oman - Pakistan - Palau - Panama - Papua - Neuguinea - Paraguay - Peru  
 - Philippinen - Pitcairn Inseln - Polen - Portugal - Puerto Rico - Qatar - Reunion -  
 Rumänien - Russland - Ruanda - Samoa - Sankt Helena - Sankt Kitts und Nevis -  
 Sankta Luzia - Sankt Pierre und Miquelon - Sankt Vincent und die Grenadinen - San  
 Marino - Sao Tome und Principe - Saudi Arabien - Senegal - Seychellen, die - Sierra  
 Leone - Singapur - Slowakei - Slowenien - Salomonseln, die - Somalia - Südafrika -  
 Südgeorgien und die Sandwidchinseln - Spanien - Sri Lanka - Sudan - Surinam -  
 Spitzbergen und Jan Mayen Inseln - Swasiland - Schweden - Schweiz - Syrien -  
 Taiwan - Tadschikistan - Tansania - Thailand - Togo - Tokleau - Tonga - Trinidad  
 und Tobago - Tunesien - Türkei - Turkmenistan - Türkische und Caicosische Inseln -  
 Tuvala - Uganda - Ukraine - Vereinigte Arabische Emirate - Großbritannien und  
 Nordirland - U.S.A. - Vereinigte Staaten (kleinere Inseln) - Uruguay - Usbekistan -  
 Vanuatu - Vatikan - Venezuela - Vietnam - Jungferninseln (Britisch) - Virgin Islands  
 - Wallis und Futuna Inseln - Yemen - Jugoslawien - Sambia - Simbabwe - Anderes  
 Land

### **Land / Region Ihrer Herkunft**

Bitte auswählen:

Österreich - Deutschland - U.S.A. - Afghanistan - Albanien - Algerien - Andorra -  
 Angola - Anguilla - Antarktis - Antigua und Barbuda - Argentinien - Armenien -  
 Aruba - Australien - Aserbaidshan - Bahamas - Bahrain - Bangladesch - Barbados -  
 Belarus - Belgien - Belize - Benin - Bermuda - Bhutan - Bolivien - Bosnien-  
 Herzegowina - Botswana - Bouvet Islands - Brasilien - Britisch-Indischer Ozean -  
 Brunei - Bulgarien - Burkina Faso - Burundi - Kambodscha - Kamerun - Kanada -  
 Kap Verde - Cayman Islands - Zentralafrikanische Republik - Tschad - Chile - China  
 - Weihnachtsinsel - Cocos (Keeling) Islands - Kolumbien - Comoros - Kongo -  
 Kongo, Demokratische Republik von - Cook Islands - Costa Rica - Elfenbeinküste -  
 Kroatien - Kuba - Zypern - Tschechische Republik - Dänemark - Djibouti - Dominica  
 - Dominikanische Republik , Ost-Timor - Ecuador - Ägypten - El Salvador -  
 Äquatorial-Guinea - Eritrea - Estland - Äthiopien - Falkland Inseln - Faröer Inseln -  
 Fidschi Inseln - Finnland - Frankreich - Französisch Guayana - Französisch

Polynesien - Französische Südprovinzen - Gabun - Gambia - Georgien - Ghana - Gibraltar - Griechenland - Grönland - Grenada - Guadeloupe - Guam - Guatemala - Guiana - Guiana-Bissau - Guyana - Haiti - Heard and McDonalds Island - Honduras - Hong Kong S.A.R. - Ungarn - Island - Indien - Indonesien - Iran - Irak - Irland- Israel - Italien - Jamaika - Japan - Jordanien - Kasachstan - Kenia - Kiribati - Korea - Nordkorea - Kuwait - Kirgisistan - Laos - Lettland - Libanon - Lesotho - Liberien - Lybien - Liechtenstein - Litauen - Luxembour - Macau S.A.R. - Mazedonien, Ehemalige Jugoslawische Republik von - Madagaskar - Malawi - Malaysia - Malediven - Mali - Malta - Marshall Islands - Martinique - Mauretania - Mauritius - Mayotte - Mexiko - Mikronesien - Moldawien - Monaco - Mongolei - Montserrat - Marokko - Mosambik - Myanmar, früher Birma - Namibia - Nauru - Nepal - Niederländische Antillen - Niederlande, Die - Neukaledonien - Neuseeland - Nikaragua - Niger - Nigeria - Niue - Norfolk Inseln - Nord Mariana Inseln - Norwegen - Oman - Pakistan - Palau - Panama - Papua - Neuguinea - Paraguay - Peru - Philippinen - Pitcairn Inseln - Polen - Portugal - Puerto Rico - Qatar - Reunion - Rumänien - Russland - Ruanda - Samoa - Sankt Helena - Sankt Kitts und Nevis - Sankta Luzia - Sankt Pierre und Miquelon - Sankt Vincent und die Grenadinen - San Marino - Sao Tome und Principe - Saudi Arabien - Senegal - Seychellen, die - Sierra Leone - Singapur - Slowakei - Slowenien - Salomonen, die - Somalia - Südafrika - Südgeorgien und die Sandwicheinseln - Spanien - Sri Lanka - Sudan - Surinam - Spitzbergen und Jan Mayen Inseln - Swasiland - Schweden - Schweiz - Syrien - Taiwan - Tadschikistan - Tansania - Thailand - Togo - Tokelau - Tonga - Trinidad und Tobago - Tunesien - Türkei - Turkmenistan - Türkische und Caicosische Inseln - Tuvalu - Uganda - Ukraine - Vereinigte Arabische Emirate - Großbritannien und Nordirland - U.S.A. - Vereinigte Staaten (kleinere Inseln) - Uruguay - Usbekistan - Vanuatu - Vatikan - Venezuela - Vietnam - Jungferninseln (Britisch) - Virgin Islands - Wallis und Futuna Inseln - Yemen - Jugoslawien - Sambia - Simbabwe - Anderes

Land

## N. ANOVA Table for Beta Time 2

Table 5

*Analysis of Variance employing as Dependent Variable the ERSP for the Frequency Band Beta (13 - 21 Hz) which was calculated by comparing the baseline of 500 ms pre-stimulus to the time window 2 (T2) of 3250-4250 ms post-stimulus*

Source	<i>df</i>	<i>F</i>	$\eta$	<i>p</i>
Between subjects				
Familiarity (F)	1	0.06	.00	.802
F within-group error	67	(0.37)		
Within subjects				
Pain (P)	1.00	14.14**	.17	.000
Race (R)	1.00	0.33	.00	.563
Area (A)	1.81	20.06**	.23	.000
Side (S)	1.90	3.05	.04	.067
P × F	1.00	0.23**	.00	.627
P × A	1.83	5.11**	.07	.005
P × A × F	1.83	1.02	.01	.369
P × S	1.52	1.29	.01	.274
P × S × F	1.52	0.73	.01	.454
P × A × S	3.16	1.35	.02	.250
P × A × S × F	3.16	1.08	.01	.364
R × F	1.00	5.57**	.07	.021
R × A	1.83	1.25	.01	.288
R × A × F	1.83	4.04*	.05	.024
R × S	1.70	1.25	.01	.285
R × S × F	1.70	0.22	.00	.795
R × A × S	3.81	1.46	.02	.219
R × A × S × F	3.81	0.25	.00	.893
P × R	1.00	5.34	.00	.468
P × R × F	1.00	2.49	.03	.119
P × R × A	2.01	4.31*	.06	.017
P × R × A × F	2.01	1.26	.01	.284
P × R × S	1.80	1.29	.01	.272
P × R × S × F	1.80	0.56	.00	.519
P × R × A × S	3.66	1.85	.00	.940
P × R × A × S × F	3.66	1.18	.01	.318
A × F	1.81	0.31	.00	.731
S × F	1.90	1.22	.01	.297
A × S	4.06	4.61**	.06	.002
A × S × F	4.06	0.35	.00	.907
P × R within group error	67	(1.93)		

Note. Values enclosed in parentheses represent mean square errors. *F* = Greenhouse-Geisser corrected *F* values; *df* = Greenhouse-Geisser corrected degrees of freedom.

\*  $p \leq .05$ . \*\*  $p \leq .01$ .

## **O. ABSTRACT IN GERMAN**

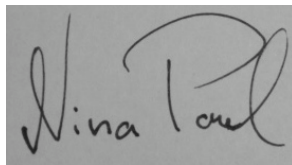
Obwohl die Literatur der Sozialpsychologie diskutiert, dass rassistische Stereotype und Vorurteile in Verbindung stehen mit verminderter Empathie, gibt es wenige Studien im Bereich der Neuropsychologie, die diesen Zusammenhang untersuchen. 37 weiß-häutigen Versuchspersonen wurden Videos präsentiert, die weiß-häutige oder schwarz-häutige Hände zeigten, welche entweder von einer Nadel gestochen (Schmerz-Bedingung) oder von einem Q-tip berührt wurden (Kein-Schmerz-Bedingung), während die Desynchronisationen im Alpha Bereich (7-14 Hz) gemessen wurde. 32 Versuchspersonen sahen die gleichen Stimuli wie die anderen 37 Versuchspersonen, jedoch waren in dieser EEG-Session die Hände digital violett eingefärbt, um den Faktor der visuellen Familiarität mit den Stimuli zu kontrollieren. In Übereinstimmung mit dem Paradigma 'Empathie für Schmerz' löste die Schmerz-Bedingung eine größere Alpha Desynchronisation aus als die Kein-Schmerz-Bedingung in frontalen, zentralen, parietalen und okzipitalen Regionen. Diese 'Empathie für Schmerz'-Antwort war signifikant niedriger für original gefärbte schwarze Stimuli als für original gefärbte weiße Stimuli in zentralen, parietalen und okzipitalen Regionen. Da die 'Empathie für Schmerz'-Antwort in zentralen Regionen ähnlich war für original gefärbte weiße Stimuli, violett gefärbte weiße Stimuli und violett gefärbte schwarze Stimuli, aber niedriger für original gefärbte schwarze Stimuli, hatte der Faktor der visuellen Familiarität keinen Einfluss darauf, dass 'Empathie für Schmerz' von ethnischer Gruppenzugehörigkeit moduliert wird. Wir argumentieren, dass die von uns gemessene Alpha Desynchronisation als somatosensorische Alpha Desynchronisation interpretiert werden kann, da die Schmerzstimuli von sich aus somatosensorischer Natur sind, da die somatosensorische Desynchronisation vor allem in einem Zeitintervall gefunden wurde, in dem keine Bewegung in den Videos zu sehen war, und da andere Studien aus unserem Forschungsgebiet ebenfalls die Interpretation von somatosensorischen Oszillationen und somatosensorischer Desynchronisation verteidigen. Die 'Empathie für Schmerz'-Antwort korrelierte mit Einschätzungen der Schmerzintensität und der Unannehmlichkeit bezüglich der EEG Stimuli, als auch mit einem explizit

gemessenen Maß des persönlichen Disstresses. Der elektrophysiologische Rassistische Bias für 'Empathie für Schmerz' korrelierte nicht mit impliziten oder expliziten Maßen des Rassistischen Bias. Jedoch korrelierte der auf Grund der Einschätzungen der Schmerzintensität und der Unannehmlichkeit bezüglich der EEG Stimuli berechnete Rassistische Bias mit dem Bevorzugen von weiß-häutigen Menschen und mit der Einstellung gegenüber schwarz-häutigen Menschen.

## **P. Declaration**

Ich versichere:

- 1.) dass ich die Diplomarbeit selbstständig verfasst, keine anderen als die angegebenen Quellen und Hilfsmittel benutzt und mich auch sonst keiner unerlaubten Hilfe bedient habe.
- 2.) dass ich diese Diplomarbeit bisher weder im In- noch im Ausland in irgendeiner Form als Prüfungsarbeit vorgelegt habe.
- 3.) dass ich mich bemüht habe, sämtliche Inhaber der Bildrechte ausfindig zu machen und ihre Zustimmung zur Verwendung der Bilder in dieser Arbeit eingeholt habe. Sollte dennoch eine Urheberrechtsverletzung bekannt werden, ersuche ich um Meldung bei mir.

A handwritten signature in black ink on a light gray background. The signature reads "Nina Paul" in a cursive, flowing script. The first name "Nina" is written in a smaller, more compact style, while the last name "Paul" is larger and more prominent, with a large, sweeping loop for the letter 'P'.



# Curriculum Vitae

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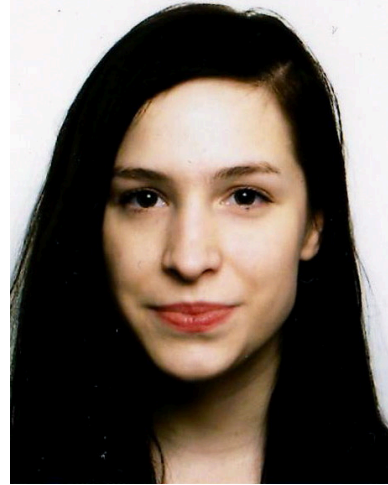
## Nina Paul

Born: April 19<sup>th</sup> 1986 in Berlin, Germany

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10719 Berlin, Germany, EU

440 Dinwiddie Street, Apt. 2  
Portsmouth, Virginia 23704, USA

E-Mail: NinaPaul@gmx.de



## Education

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- |                        |   |
|------------------------|---|
| Oct. 2006 – May 2012   | University of Vienna, Austria, EU<br>Magister studies in Psychology<br>Advanced classes in Clinical and Neuropsychology |
| Jan. 2010 – June 2010  | University of Chicago, Illinois, USA<br>Joint Study Exchange  |
| Sept. 2005 – July 2006 | Au pair Exchange Program, New York, USA   |
| Oct. 2002              | High School Exchange, Arkansas, USA   |
| Aug. 1998 – June 2005  | Goethe High School, Berlin, Germany, EU   |
| Aug. 1992 – June 1998  | Private Kant Elementary School, Berlin, Germany, EU   |

## Employment History

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- |                       |   |
|-----------------------|---|
| Aug. 2008 – Jul. 2011 | Resident assistant at the Institute for the International Education of Students |
|-----------------------|---|



## **Research Experience**

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Oct. 2010 – April 2011      EEG laboratory research at the Social, Cognitive and Affective Neuroscience Unit (SCAN-Unit) at the Institute for Clinical, Biological and Differential Psychology at the University of Vienna

## **Clinical Experience**

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Aug. 2010 – Oct. 2010      Intern at the Therapy Center for Drug Rehabilitation at the Otto-Wagner Hospital

## **Teaching Experience, Service to the University**

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Mar. 2009 – Dec. 2009      Mentor program at the University of Vienna teaching students basic research abilities

## **Awards**

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Sept. 2011                      Scholarship to support the research for the project of the Magister thesis granted by the University of Vienna

Jan. 2010                        Scholarship for the Joint Study Program at the University of Chicago granted by the University of Vienna

## **Publications**

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planned                         Publication of the Magister thesis as an article

## **Skills**

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Languages                      English, German

Software                        SPSS, EEGLAB in MATLAB, E-Prime